

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

aTC425
.D5U5

PLAN

FOR WATERSHED PROTECTION
AND FLOOD PREVENTION

DIAMOND BROOK WATERSHED

NORFOLK COUNTY
MASSACHUSETTS

DECEMBER 1975

ADVISORY BOARD
1900

NATIONAL

A
G
R
I
C
U
L
T
U
R
A
L



LIBRARY

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY

JAN - 5 1977

CATALOGING - PREP.

DIAMOND BROOK

WATERSHED

Norfolk County, Massachusetts

ADDENDUM

INTRODUCTION

The purpose of this addendum is to satisfy requirements established by the Council of Representatives of the Water Resources Council.✓ In accordance with Water Resources Council guidelines this addendum contains the following information presented in three separate sections:

- I. An evaluation of the plan, without reformulation, using the current discount rate of $6 \frac{1}{8}$ percent, and current prices for benefits and installation costs.
- II. An abbreviated environmental quality plan consistent with the intent of the "Principles and Standards."
- III. An abbreviated display of the national economic development, regional development, environmental quality, and social well-being impacts consistent with the intent of the "Principles and Standards."

I. COMPARISON OF BENEFITS AND COSTS USING CURRENT DISCOUNT RATE OF 6 1/8 PERCENT AND CURRENT PRICES FOR BENEFITS AND INSTALLATION COSTS.

The economic justification for the selected plan was tested on the basis of Senate Document No. 97, as supplemented and amended, using 1975 installation costs, a 6 1/8 percent discount rate and current prices for benefits. On this basis, average annual benefits are \$86,490 and average annual costs are \$53,320. The benefit-cost ratio is 1.6 to 1. Without secondary benefits, the benefit-cost ratio is 1.5 to 1.

II. ABBREVIATED ENVIRONMENTAL QUALITY PLAN.

Improvement in the quality of life can be achieved with water and land resource management and development directed at improving the quality of the environment. The objective in formulating this abbreviated plan is to emphasize the environmental quality objective aspects within the Diamond Brook Watershed.

Environmental Problems

Poor air and water quality affecting both fisheries habitat and the human environment has caused much concern among local residents in the watershed. This problem is related to the existence of septic sewage systems on soils with severe septic system limitations. Due to poor site location, the leachate finds its way into water courses and subsequently reduces the quality of the receiving water. In addition, increased urbanization and resulting urban runoff contribute to poor water quality.

The quantity and quality of open space for natural beauty, wildlife habitat, and other beneficial uses is decreasing throughout the watershed. This land is decreasing at the rate of approximately 10 acres per year, largely from spreading urbanization. Quality of the total wildlife habitat acreage is depressed due to the scarcity of agricultural land and presence of extensive acreages of pole sized woodland with a closed canopy. Habitat management is lacking throughout the watershed.

Erosion and sediment damages within the watershed are presently within acceptable limits. Urbanization however, is expected to cause soil loss and sedimentation in the future unless proper control and management measures are implemented. Unregulated development could adversely affect both water quality and fish and wildlife habitat, and generally reduce the quality of the environment.

Component Needs

Component needs include the following:

1. Improve land, air, and water quality.
2. Establish and manage fish and wildlife habitat areas.
3. Establish areas of natural beauty.

Elements of the Environmental Quality Plan ^{1/}

1. Minimize the sources of pollution. This will require a stream survey and monitoring of water quality and the enforcement of state and local public health laws related to sewage disposal systems. The cost of modifications and proper maintenance of existing sewage disposal systems is estimated to be \$5,000 annually.
2. Acquire 245 ^{2/} acres of forest land to be dedicated to public open space and upland wildlife purposes. A total of five parcels will be obtained including three 15-acre ^{2/} parcels, and two 100-acre ^{2/} parcels. Estimated land rights cost for this measure is \$490,000.

Establish 20 acres of open land wildlife habitat, within the 245-acres, in order to provide diversity of food and cover for wildlife. The estimated construction cost of this item is \$40,000 and will include clearing and grubbing as well as seeding and fertilizing.

Improve 225 acres of the remaining forest land for upland wildlife habitat by establishing woodland openings, seeding existing woodland trails and reducing stand densities. The construction cost of this item will be about \$6,750.

Provide additional public access to upland wildlife lands through the establishment of one mile of nature trails. The estimated cost for clearing and seeding is \$5,000.

Operate and maintain this 245 acres of land to include mowing, liming, and fertilizing of grasslands and maintenance of proper woodland cover. The estimated annual O&M cost is \$1,200. Total installation cost for the above measure is estimated to be \$566,000 including \$490,000 for land rights, \$51,750 for grubbing, clearing, fertilizing, seeding, and the remainder for technical assistance, administration, surveys, and legal fees.

3. Acquire 32 ^{2/} acres of primarily inland open fresh water and shrub swamp wetlands for wetland wildlife habitat. Land rights cost for this measure is estimated to be \$12,800.

Install eight one-half-acre shallow ponds for wetland wildlife on this 32 acre tract. Installation costs for this item are estimated to be \$8,000.

^{1/} Estimated costs for all elements of the Environmental Quality Plan are price base 1975. All O&M costs are adjusted for future values expected to occur during the 100-year evaluation period.

^{2/} From Criteria Developed for the Natural Resources Planning Program, First Draft, Unpublished Data, USDA, Soil Conservation Service, Amherst, Massachusetts. January 1974.

Total installation costs for the above measures is estimated to be \$24,000 including \$12,800 for land rights, \$8,000 for construction and the remaining \$3,200 for technical assistance, surveys, legal fees and administration. Annual O&M for the above measures are estimated to be \$1,000.

4. Obtain an easement on a natural stream corridor^{1/} approximately 100 feet wide along 1.0 miles of existing stream for preservation of fish and wildlife habitat and natural beauty. The estimated cost for this measure is \$30,000 including \$24,000 for land rights and \$6,000 for survey and legal fees.
5. Acquire for public enjoyment a 50-foot perimeter around Diamond and Allen Ponds and access roads to each pond. Total installation costs for this measure are estimated to be \$70,000 including \$60,000 for land rights. Annual O&M costs are estimated to be \$1,000.
6. Apply needed conservation land treatment practices on all watershed land subject to excessive sediment and erosion damage. This will consist of temporary basins to trap sediment, measures to convey runoff water in a non-erosive manner, seeding, tree planting, and mulching. The estimated total installation cost of this measure is \$75,700 including \$5,600 for technical assistance to landowners and operators.

INSTITUTIONAL ARRANGEMENTS AVAILABLE AND NEEDED FOR THE IMPLEMENTATION OF THE ENVIRONMENTAL QUALITY PLAN (EQ PLAN)

Legal entities of government with authority for implementation of the EQ Plan already exist. They include town and county governments, and joint powers of county government and the Norfolk Conservation District. All of these have the power of eminent domain and taxation.

Several private, state and federal programs which provide financial assistance for land acquisition and establishment of measures to implement the EQ Plan are as follows:

1. Federal Assistance Programs

(a) PROGRAMS PRIMARILY FOR LAND AREAS

- (1) PL89-117, Housing and Urban Development Act: This act authorizes an open space land program under which federal funds provide fifty percent of the cost of acquisition and development of land for recreation, conservation, or other public uses which conform to the comprehensive plan of that locality. This includes purchase and clearance of land in built-up areas for such open space needs as parks, squares, and playgrounds.

^{1/} From Criteria Developed for the Natural Resources Planning Program, First Draft, Unpublished Data, USDA, Soil Conservation Service, Amherst, Massachusetts. January 1974.

- (c) The Planning Division of the Department of Commerce and Development provides planning advisory assistance to communities, and administers the Federal Urban Planning Assistance Program in the Commonwealth.
- (d) Pitman-Robertson Funds provide for wildlife research and financial and technical assistance in developing wildlife habitat areas. The funds are administered by the state.

3. Private Assistance Programs

The Massachusetts Audubon Society and Trustees of Reservations purchase land for wildlife and conservation purposes.

ENVIRONMENTAL EFFECTS OF THE ENVIRONMENTAL QUALITY PLAN

Implementation of the EQ Plan in the Diamond Brook Watershed would attain environmental quality objectives and consequently provide environmental benefits to both present and future generations.

1. The improvement and proper maintenance of existing inadequate sewage disposal systems would significantly reduce the coliform counts, and thus remove one of the constraints limiting the attainment of Class "B" water quality in Diamond Brook. The associated pollution from inadequate septic systems would also be essentially eliminated.
2. The following measures would improve, preserve, and maintain areas of natural beauty and open space for wildlife habitat and human visitation:
 - (a) The acquisition of 245 acres of predominantly upland woodland.
 - (b) The clearing of 20 acres of woodland and conversion to grassland.
 - (c) The installation of one mile of nature trails.
 - (d) The acquisition of 32 acres of wetland Type $2\frac{1}{2}$ (Inland Fresh Meadow), Type $5\frac{1}{2}$ (Inland Open Fresh Water), and Type $6\frac{1}{2}$ (Shrub Swamp).
 - (e) The creation of eight $1\frac{1}{2}$ -acre shallow ponds.
 - (f) Obtaining an easement on about 12 acres of predominantly Type $7\frac{1}{2}$ wetlands (Wooded Swamps) and upland hardwoods along 1.0 miles of Diamond Brook.
 - (g) The acquisition of 6 acres around the perimeter of Diamond and Allen Ponds which consist of 3 acres of woodland and 3 acres of herbaceous plant cover.
 - (h) The establishment of public access roads to Diamond and Allen Ponds.

^{1/} Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

3. Erosion would be reduced from 18/tons/acre/year on urbanizing lands to an acceptable limit of approximately 4/tons/acre/year through the application of land treatment practices. This would also result in the reduction of associated sedimentation problems and in the improvement of the quality of land resources.
4. The implementation of the EQ Plan would affect land use patterns as follows:
 - (a) Of the present 587 acres of forest land, about 20 acres would be converted to open land and cleared for wildlife purposes.
 - (b) Of the 14-acres of existing Type 6 ¹/₂ wetlands, 4 acres would be converted to Type 4 ¹/₂ wetlands.

¹/₂ Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

III. ABBREVIATED DISPLAY OF THE SELECTED PLAN.

Selected PlanDiamond Brook Watershed Project, MassachusettsNATIONAL ECONOMIC DEVELOPMENT ACCOUNT

<u>Components</u>	<u>Measures of Effects 1/</u>	<u>Components</u>	<u>Measures of Effects 1/</u>
Income:		Income:	
BENEFICIAL EFFECTS:		ADVERSE EFFECTS:	
A. The value to users of increased outputs of goods and services		A. The value of resources required for the plan	
1. Flood Prevention	\$80,730 <u>2/</u>	1. Floodwater retarding structure and multi-purpose reservoir	
		a. Structural measures for flood prevention	\$19,830
		b. Structural measures for fish and wildlife	6,470
		c. O&M flood prevention	870
		d. O&M fish and wildlife	350
		e. Project administration	3,640
		2. Channel modification (M) <u>3/</u>	
		a. Structural measures for flood prevention	21,370
		b. O&M flood prevention	1,910
		c. Project administration	3,730
Total Beneficial Effects	\$80,730	Total Adverse Effects	\$58,170
		Net Beneficial Effects	22,560

1/ Average Annual Values, Price Base 1975.

2/ \$1610 Damage Reduction From Land Treatment Not Included.

3/ Type of Channel Before Project (M)-Man-made Ditch or Previously Modified Channel.

Selected PlanDiamond Brook Watershed Project, MassachusettsREGIONAL DEVELOPMENT ACCOUNT

<u>Components</u>	<u>Measures of Effects 1/</u>		<u>Components</u>	<u>Measures of Effects 1/</u>	
	<u>State of</u> <u>Massachusetts</u>	<u>Rest of</u> <u>Nation</u>		<u>State of</u> <u>Massachusetts</u>	<u>Rest of</u> <u>Nation</u>
A. Income:			A. Income:		
BENEFICIAL EFFECTS:			ADVERSE EFFECTS:		
1. The value of increased output of goods and services to users residing in the region.			1. The value of resources contributed from within the region to achieve the outputs.		
a. Flood prevention	\$80,730 2/	-	a. Floodwater retarding structure and multi-purpose reservoir.		
b. Secondary	6,630	-	(1) Structural measures for flood prevention	-	\$19,830
			(2) Structural measures for fish and wildlife	\$4,270	2,200
			(3) O&M for flood prevention	870	-
			(4) O&M for fish and wildlife	350	-
			(5) Project administration	180	3,460
			b. Channel modification (M) 3/		
			(1) Structural measures for flood prevention	3,080	18,290
			(2) O&M for flood prevention	1,910	-
			(3) Project administration	400	3,330
B. Employment	Data is Not Relevant or Available				
C. Population Distribution	Data is Not Relevant or Available				
D. Regional Economic Base and Stability	Data is Not Relevant or Available				
Total Beneficial Effects	\$87,360	-	Total Adverse Effects	\$11,060	\$47,110
			Net Beneficial Effects	+76,300	-47,110

1/ Average Annual Values, Price Base 1975.

2/ \$1,610 Damage Reduction From Land Treatment Not Included.

3/ Type of Channel Before Project (M) - Man-Made Ditch or Previously Modified Channel.

Selected Plan
Diamond Brook Watershed Project, Massachusetts
ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>
Beneficial & Adverse Effects:	
A. Areas of Natural Beauty.	1. Provision of dedicated open space consisting of 57 acres of land committed to the multiple-purpose structure.
B. Quality considerations of water, land, and air resources.	1. Reduction of sediment and erosion from areas being urbanized. 2. Application of project-derived resource inventory data to land use planning.
C. Biological resources and selected ecosystems.	1. Creation of a 17-acre pool which will support a warm water fishery and wetland wildlife. This man-made aquatic environment will constitute a Type 5 ^{1/} wetland after plant succession. 2. Creation of 10 acres of openland wildlife habitat resulting from installation of the multiple-purpose structure. 3. Creation of 2,800 feet of wildlife "edge" formed by the perimeter of the dam and spillway and the adjacent woodland. 4. Increase wildlife habitat value of one-quarter acre now covered with broken concrete pavement. 5. Reduction of 12 acres of Type 7 ^{1/} wetland and 1 acre of Type 2 ^{1/} wetland will result from the fish and wildlife pool and channel work. The 12-acres of Type 7 ^{1/} wetland also constitutes a forest resource. 6. Reduction of 15 acres of forest resource and associated wildlife habitat will result from clearing for the dam, spillway, borrow area, and fish and wildlife pool.

^{1/} Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

Selected Plan
Diamond Brook Watershed Project, Massachusetts
ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>
	<ul style="list-style-type: none"> 7. Occasional temporary loss of 16 acres of wetland wildlife habitat and 14 acres of woodland wildlife habitat will result from floodwater storage. 8. Reduction of 850 feet of perennial stream habitat will result from the dam and fish and wildlife pool. 9. Reduction of 400 feet of intermittent stream habitat will result from the fish and wildlife pool. 10. Occasional temporary loss of 250 feet of intermittent stream habitat will result from floodwater storage. 11. Increase water temperature downstream of the fish and wildlife pool by 2° to 4°F. 12. Impairment of 37 acres of wildlife habitat due to recreational use. 13. Reduction of the quality of aquatic habitat in 400 feet of perennial stream will result from the channel modification.
D. Irreversible or irretrievable commitment.	<ul style="list-style-type: none"> 1. Forest and wildlife uses will be eliminated on the 17-acres of land occupied by the fish and wildlife pool. 2. Periodic inundation of up to 33 acres of mostly wooded land in the floodwater detention pool will impair its wildlife habitat. 3. Forest use will be eliminated on about 9 acres of construction area. Wildlife use of this area will be lost until revegetated after construction. 4. About 0.1 mile of intermittent stream channel and 0.2 mile of perennial flowing stream will be lost to the fish and wildlife pool and earth fill.

Selected Plan
Diamond Brook Watershed Project, Massachusetts
ENVIRONMENTAL QUALITY ACCOUNT

ComponentsMeasures of Effects

5. The commitment of about 57 acres of land to the multi-purpose structure will preclude the use of the area for uses not compatible with the intended purpose of the structure.
6. Other commitments including the labor and materials which will be expended to install, operate and maintain the project are irreversible. These commitments however can and will be retrieved in the form of project benefits. The only commitments which can be retrieved in a form other than project benefits are fill and other related materials used in construction.

SOCIAL WELL-BEING ACCOUNTComponentsMeasure of Effect

Beneficial and Adverse Effects:

- A. Life, Health and safety.
 1. Reduction of average annual floodwater damages along Diamond Brook by 99 percent. Protection provided for roads, bridges, 15 residences, a school, and 75 commercial establishments.
 2. Temporary increase of noise, air pollution, erosion, and sedimentation caused by construction activities.
 3. Temporary disruption of traffic, and utility services and business during installation of the conduit.
- B. Recreation opportunities.
 1. Creation of a 17-acre pool for public fishing and provision of 20 acres of adjacent public land for passive recreation.
 2. Loss of hunting use on 37 acres of land.
- C. Real Income Distribution Data is Not Relevant or Available.

WATERSHED PLAN
DIAMOND BROOK WATERSHED

Norfolk County

Massachusetts

Prepared under the Authority of the Watershed
Protection and Flood Prevention Act (Public Law
566, 83rd Congress, 68 Stat. 666), as amended.

Prepared by: Norfolk Conservation District

Town of Walpole

with assistance by:

U. S. Department of Agriculture, Soil Conservation Service
U. S. Department of Agriculture, Forest Service
Massachusetts Water Resources Commission
Massachusetts Division of Fisheries and Game
Massachusetts Division of Forests and Parks

DECEMBER
1975

WATERSHED PLAN AGREEMENT

between the

Norfolk Conservation District

Local Organization

Town of Walpole

Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

Commonwealth of Massachusetts

and the

Soil Conservation Service

United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Diamond Brook Watershed, Commonwealth of Massachusetts, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Diamond Brook Watershed, Commonwealth of Massachusetts, hereinafter referred to as the watershed plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed plan:

1. The town of Walpole will acquire, with other than PL 566 funds, such land rights as will be needed in connection with the works of improvement. (estimated cost \$93,600).

The town of Walpole agrees that all land acquired or improved with PL 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	20.9	79.1	0 ^{1/2}

3. The town of Walpole will acquire or provide assurance that land owners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

^{1/2} Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

4. The percentages of construction costs of structural measures to be paid by the town of Walpole and by the Service are as follows:

<u>Works of Improvement</u>	<u>Town of Walpole (percent)</u>	<u>Service (percent)</u>	<u>Estimated Construction Cost (dollars)</u>
Allen site multiple- purpose structure	8.5	91.5	\$368,000
Single purpose channel work (Floodwater conduit and outlet channel)	0	100.0	282,000

5. The Service will bear the costs of all engineering services applicable to structural works of improvement (estimated cost \$65,000).
6. The town of Walpole and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$9,800 and \$115,200 respectively.
7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above the floodwater retarding structure stating that they will carry out recommended conservation measures on their land.
8. The Norfolk Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed plan.
9. The Norfolk Conservation District will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The town of Walpole will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction works.
11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed plan is contingent on the availability of appropriations for this purpose.

A separate agreement will be entered into between the Service and the town of Walpole before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed plan may be amended or revised and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, and the regulations of the Secretary of Agriculture (7C.F.R.Sec. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

NORFOLK CONSERVATION DISTRICT

460 Main St.
Walpole, Mass. 02081
Address Zip Code

By William O. Sweet
Title Chairman
Date February 23, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Norfolk Conservation District, adopted at a meeting held on February 23, 1976 .

Fred Leonard
Secretary, Local Organization
Date February 23, 1976

460 Main St.
Walpole, Mass. 02081
Address Zip Code

TOWN OF WALPOLE
Town Hall
Walpole, MA 02081
Address Zip Code

By Charles F. Bow
By John J. Fanning
By Philip J. Macpherson
By Robert W. Hodder
By Charles H. McCann

Title: Board of Selectmen
Address Town Hall, Walpole, MA 02081
 Zip Code
Date February 24, 1976

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by: [Signature]
MAR 3 1976
Date

TABLE OF CONTENTS

	<u>Page</u>
SUMMARY OF THE PLAN	1
ENVIRONMENTAL SETTING	4
Physical Resources	4
Plant and Animal Resources	20
Economic Resources	33
Recreational Resources	35
Archaeological and Historical and Unique Scenic Resources	36
Soil, Water and Plant Management Status	36
WATER AND RELATED LAND RESOURCE PROBLEMS	38
Land and Water Management	38
Floodwater Damage	38
Erosion and Sediment Damage	39
Municipal and Industrial Water Supply Problems	39
Recreation Problems	42
Plant and Animal Resource Problems	42
Water Quality Problems	42
PROJECTS OF OTHER AGENCIES	43
PROJECT FORMULATION	44
Objectives	44
Environmental Considerations	45
Alternatives	45
Reasons for Selecting the Planned Project	48
WORKS OF IMPROVEMENT TO BE INSTALLED	50
Land Treatment	50
Structural Measures	51
Nonstructural Measures	56
Land Use Changes	58
EXPLANATION OF INSTALLATION COSTS	64
EFFECTS OF WORKS OF IMPROVEMENT	68
Conservation Land Treatment	68
Structural Measures	68
Economic and Social	71

TABLE OF CONTENTS

	<u>Page</u>
PROJECT BENEFITS	73
COMPARISON OF BENEFITS AND COSTS	74
PROJECT INSTALLATION	75
Responsibilities for Installation	76
Installation Schedule	78
FINANCING PROJECT INSTALLATION	79
Land Treatment Measures	79
Structural Measures	79
PROVISIONS FOR OPERATION AND MAINTENANCE	80
Land Treatment Measures	80
Structural Measures	80
Nonstructural Measures	81
INVESTIGATIONS AND ANALYSES	90
PROJECT FORMULATION	90
HYDRAULICS AND HYDROLOGY	91
ECONOMICS	94
ENGINEERING	95
GEOLOGY	97
TABLES	
Table A - Wetlands in the Watershed	12
Table B - Low Flow Measurements	15
Table C - Water Quality Measurements	17, 18
Table D - Relative Abundance of Principal Game Species	30
Table E - Summary of Plant Communities	31
Table F - Present Land Use of Area Required for Structures	58
Table 1 - Estimated Project Installation Cost	82
Table 2 - Estimated Structural Cost Distribution	83
Table 2A - Cost Allocation and Cost Sharing Summary	84
Table 3 - Structural Data - Structures with Planned Storage Capacity	85
Table 3A - Structural Data - Channels	86
Table 4 - Annual Cost	87
Table 5 - Estimated Average Annual Flood Damage Reduction	88
Table 6 - Comparison of Benefits and Costs for Structural Measures	89

TABLE OF CONTENTS

	<u>Page</u>
FIGURES	
Figure A - Location Map	5
Figure B - Bedrock Geology	8
Figure C - Surficial Geology	10
Figure D - Location of Water Sampling Stations	19
Figure E - Plant Communities Map	32
Figure F - Boston Standard Metropolitan Statistical Area	34

Figures located at back of work plan:

Figure 1 - Allen Site Reservoir
Figure 1A - Typical Multiple-Purpose Structure
Figure 2 - Channel Improvement
Figure 3 - Inundated Area Map (Diamond Brook)
Figure 4 - Effects of Project (Diamond Brook)
Figure 5 - Project Map

WATERSHED PLAN

DIAMOND BROOK WATERSHED

Norfolk County, Massachusetts

December 1975

SUMMARY OF PLAN

The Diamond Brook Watershed, located about twenty miles south of Boston, has a total drainage area of approximately 1,270 ^{1/} acres situated in the towns of Walpole and Sharon within Norfolk County, Massachusetts. Diamond Brook (also known as Spring Brook), drains directly into the Neponset River and is the only tributary within the watershed.

The Norfolk Conservation District and the town of Walpole, the sponsoring local organizations, developed this plan with technical assistance from state and federal agencies.

Flooding of roads, bridges, and residential and commercial properties located along the lower reaches of Diamond Brook is a major problem. Increased runoff, accelerated erosion and sediment production on lands, being or to be, converted to urban use is a major concern. The need to protect and improve the quality of the environment is of parallel and equal concern.

Measures included in the plan to alleviate these problems consist of conservation land treatment, a multiple-purpose structure at the Allen site with storage for floodwater, and fish and wildlife, and about 1,180 feet of channel work for flood prevention. The channel work involves the installation of about 780 feet of reinforced concrete conduit to supplement an existing conduit and enlargement of about 400 feet of stream channel. Diamond Brook, in the channel work area, is a perennially flowing and previously modified stream. The planned measures will be installed within a 5-year period.

The total estimated project installation cost is \$1,014,900 of which \$803,400 will be borne by Public Law-566 funds and \$211,500 from other funds.

Land treatment measures will be installed throughout the watershed for control of runoff and erosion, and protection and improvement of fish, wildlife, recreation and environmental values. Measures will be installed by landowners and developers with technical assistance provided through the Norfolk Conservation District by state and federal agencies. Technical assistance will also be provided to watershed towns in preparing natural

^{1/} All information and data, except as otherwise noted by reference to source, were collected during watershed planning investigations by the Soil Conservation Service, U.S. Department of Agriculture and the Forest Service, U.S. Department of Agriculture.

resource plans to serve as a basis for implementing land use changes and other measures to protect and enhance natural resources and their environmental values. The estimated total cost of the land treatment phase of the project is \$81,300 of which \$4,300 will be borne by Public Law-566 funds and \$77,000 from other funds. Public Law-566 funds will be used for accelerated technical assistance, of which \$2,200 will be provided through the Soil Conservation Service and \$2,100 through the Forest Service.

The multiple-purpose structure and channel work, will supplement the land treatment measures to effectively solve the principal floodwater problem on Diamond Brook. Protection will be provided to the major damage areas from a storm equal to that of August 1955.

The estimated installation cost for structural measures is \$933,600 of which \$799,100 will be from Public Law-566 funds and \$134,500 from other funds.

Existing zoning bylaws will be enforced to control future development along Diamond Brook and with the project measures will provide a long-term solution to the flood problems. Flood insurance is available to compensate property owners for flood losses through the town of Walpole's participation in the National Flood Insurance Program.

Annual benefits from structural measures on Diamond Brook, used for project justification, are \$87,360 with annual costs of \$51,350. The overall benefit cost ratio for the project is 1.7 to 1. Included in the benefits above are flood prevention benefits of \$80,730, and secondary benefits of \$6,630.

The proposed project will provide an estimated 99 percent reduction in average annual floodwater damages on Diamond Brook. The multiple-purpose structure will provide a 17-acre pool which will support a warm water fishery and wetland wildlife. The opportunity for fishing and other forms of passive recreation will be provided by the pool and 20 acres of adjacent public land.

About 58 acres of land will be required to install the multiple-purpose structure and channel work. The effects on existing resources of this area include: loss of 13 acres of wetland wildlife habitat and 15 acres of woodland wildlife habitat; impaired value of wildlife habitat on 16 acres of wetland and 14 acres of woodland; loss of the forest resource on 27 acres of land, loss of 850 feet of perennial stream habitat and 400 feet of intermittent stream habitat; and a reduction in the habitat quality of 400 feet of perennial stream. Temporary effects during construction activities include an increase in noise, air pollution, erosion and sedimentation, and the disruption of traffic, utility services and business.

The Massachusetts Water Resources Commission, acting through the Division of Water Resources, will be responsible for contracting for construction of the structural measures in the plan. The town of Walpole has or will acquire the necessary land rights for the project measures, and has appropriated funds for the nonfederal share of the installation costs.

Operation and maintenance of land treatment measures will be the responsibility of the Norfolk Conservation District and will be performed by the individual owners of properties on which measures are installed, with technical assistance provided through going conservation programs. Operation and maintenance of the Allen site multiple-purpose structure, the floodwater conduit and outlet channel, and the existing conduit will be the responsibility of the town of Walpole at an estimated annual cost of \$3,130.

ENVIRONMENTAL SETTING

Physical Resources

Area and Location

The Diamond Brook Watershed, in the headwaters of the Neponset River, has a total drainage area of about 1,270 acres. It is a residential and commercial area located about 20 miles southwest of Boston in Norfolk County, Massachusetts. Portions of the towns of Walpole and Sharon comprise the watershed, with respective areas of 930 and 340 acres.

This watershed is within the North Atlantic Region^{1/} (Figure A) which stretches along the Atlantic Coast from the North Carolina-Virginia state boundary to the northern tip of Maine. The region extends inland to encompass all of the land drainage which flows into the Atlantic Ocean through the coastal zone. The region is divided into six subregions as shown in Figure A. The Diamond Brook watershed is within the southern New England subregion (subregion 2).

Population

The watershed is within one of the more densely populated areas of the North Atlantic Region which is described as "an urban belt following the coastline from Boston to Washington"^{2/}. It is estimated that 5000 ^{3/} people live within the watershed area. Most of the population is in the northwestern or lower portion of the watershed within the town of Walpole.

Population is expected to increase in the watershed area at a rate of 100 people annually^{4/} during the project installation period.

^{1/} Water resource regions as delineated by the United States Water Resources Council, Washington, D.C.

^{2/} North Atlantic Regional Water Resources Study, North Atlantic Regional Water Resources Study Coordinating Committee, May 1972.

^{3/} Based on 3.76 persons per dwelling unit. From Comprehensive Plan Study, Walpole, Massachusetts, by Charles E. Downe, Planning Consultant, 1971.

^{4/} Based on Census Data; population of the town of Walpole increased about 2 percent yearly between 1965 and 1970.



Figure A

LOCATION MAP

LOCATION OF THE DIAMOND BROOK WATERSHED
WITHIN THE NORTH ATLANTIC REGION

Soils^{1/}

Soils over most of the watershed are derived from glacial deposits. Exceptions are the organic soils in the wetlands and alluvial soils along the streams, both of which are of recent geologic origin; and areas of exposed bedrock in the higher elevations of the Moose Hill area where the drainage of Diamond Brook originates.

Upland soils of glacial till origin are the primary watershed soils. Glacial outwash soils are common in the lower elevations and are typically sandy and gravelly. There are smaller areas of muck and other poorly drained soils in depressions and along the stream channels. The upland soils are stony, and although permeable, are limited in their water holding capacity due to the presence of shallow bedrock or compact glacial till. The sand and gravel soils in the lower elevations are well drained and permit large amounts of water to percolate into them.

Approximately 80 percent of the watershed area has severe soil limitations for septic tank sewage disposal. The severity of the soil limitations normally preclude use of septic tank disposal systems in these areas for high density housing. However, some of the areas in this class have less severe soil limitations and therefore, may be satisfactory for lower density housing. The soil problems involve one or more of the following conditions: (1) slow or moderately slow permeability in the substratum, (2) high water tables, that range in duration from about four or five months of the year to seven to nine months of the year or more, (3) bedrock generally within two to three feet of the surface, and (4) slopes greater than 15 percent.

Excluding soil limitations for on-site sewage disposal, there still remain severe soil limitations for housing on about 15 percent of the watershed area. These limitations involve bedrock within four feet of the surface and high water tables during most of the year.

Geology

The watershed is located in the coastal lowland section of the New England Physiographic Province. Elevations vary from about 130 feet at the confluence of Diamond Brook and the Neponset River to 525 feet at Moose Hill, the highest hill in the watershed. Most of the area consists of low rolling hills and terraces. The diversity of the topography is caused partly by the irregular bedrock surface and partly by the varied glacial and postglacial deposits.

^{1/} Soils and Their Interpretations for Various Land Uses, (Walpole, Sharon), U.S. Soil Conservation Service in Cooperation with the Norfolk Conservation District, 1965 and 1966.

Both sedimentary and igneous rocks occur in the area. Sedimentary rocks consist of interbedded shales, sandstones, and conglomerates of Pennsylvanian age. These rocks occur in the northern portion of the watershed, and are buried beneath variable thicknesses of Pleistocene and recent soil units. Igneous rocks consist of syenite with small lenses of granite, and are Pennsylvanian or older in age. These rocks occur in the southern portion of the watershed, and are usually buried beneath soil units. However, the igneous rocks are exposed in the higher elevations of the Moose Hill area in the extreme southeastern corner of the watershed.

Fault zones are the principal features of the bedrock structure which are of engineering interest. Bedrock in these zones is highly fractured, chemically altered, and often weathered and decomposed. Previous studies in surrounding areas suggest a major fault zone may run through the southeastern portion of the watershed in a northeast-southwest direction. The Blue Star Memorial Highway (U.S. Route 1) runs along the inferred location of the fault zone. Minor fault zones and highly fractured bedrock may be present locally in other parts of the watershed. Figure B shows bedrock geology and the location of the fault zone.

Pleistocene glacial deposits essentially cover the entire watershed. Silty, compact, glacial till is found at the ground surface in many places, usually on the higher hills. Locally, looser, water-washed ground moraine is found overlying the more compact till. Ice contact and glacial outwash deposits consisting of poorly graded, bedded sand and gravel form the many low hills and terraces in the watershed. The thickness of Pleistocene deposits is highly variable, and the maximum thickness in the watershed is not known. However, previous studies suggest that maximum thicknesses in the order of 200 feet or more are likely.

Recent deposits occur in swamps and along flood plains of the major streams. These consist of various mixtures of muck, silt, sand fine gravel, and peat. Deposits are usually less than five feet thick.

The general course of the Neponset River is believed to follow a pre-glacial, buried valley in the bedrock surface. The exact location of the axis, or deepest portion, of the buried valley in the watershed is not known. The axis may be located anywhere between the present river and the bedrock hills in the southern part of the watershed. Buried valleys often contain relatively thick sections of permeable glacial sediments and locally may contain preserved lenses of pre-glacial, permeable channel fill. Therefore, a buried valley may be an important source of ground water supply.

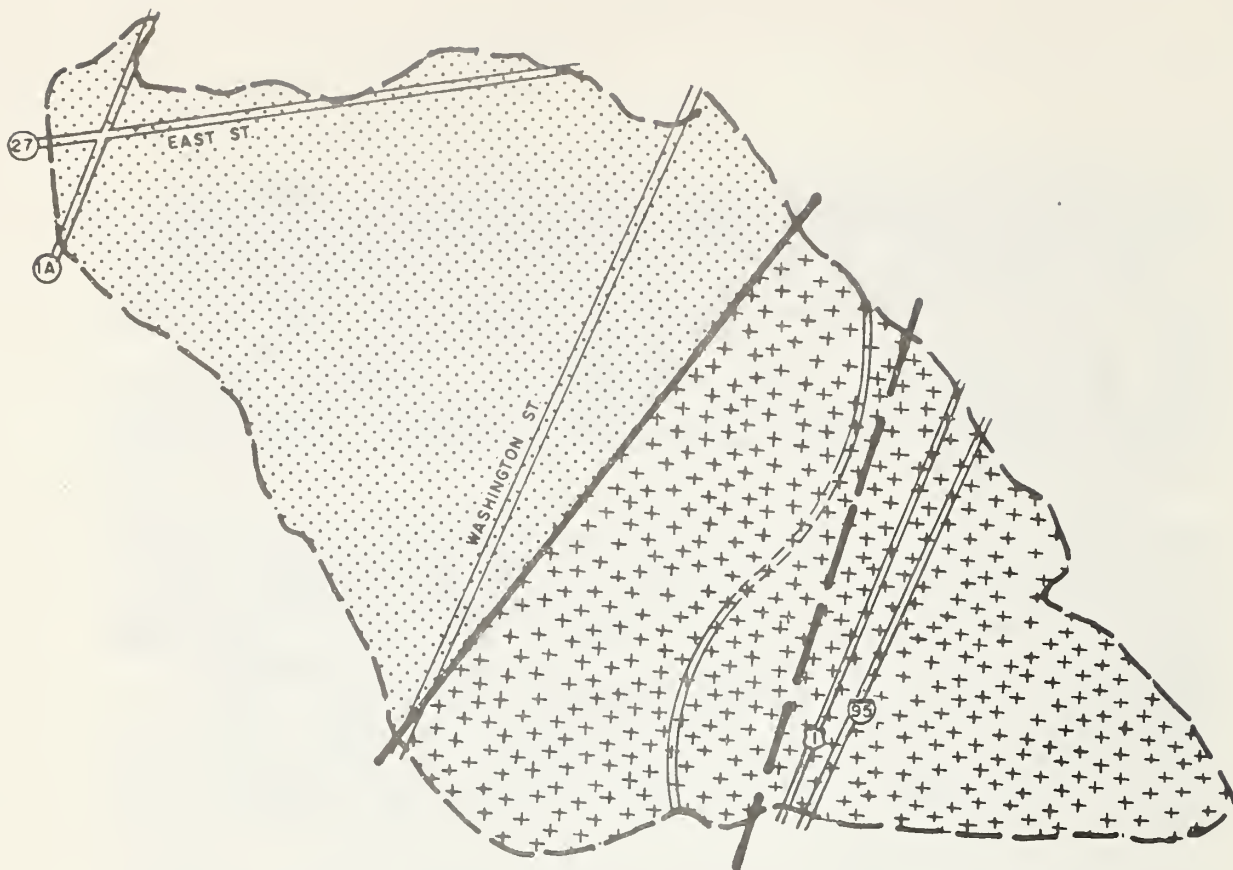
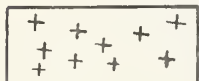


Figure B BEDROCK GEOLOGY^{1/}

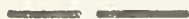
LEGEND



Pennsylvanian sedimentary rocks including interbedded shale, sandstone and conglomerate.



Pennsylvania or older igneous rocks mostly syenite with small lenses of granite.



Inferred fault. Bedrock may be expected to be highly fractured, chemically altered, and decomposed along any existing fault zones.

Note: Bedrock is concealed by thick sections of glacial sediments throughout most of the area. Therefore, locations of contacts, faults, etc., on the map are inferred and can be expected to be somewhat in error.

^{1/} Geology of the Norwood quadrangle, Norfolk and Suffolk Counties, Massachusetts, U.S. Geological Survey Bulletin 1163-B, U.S. Government Printing Office, Washington: 1966.

Some ground water sources in the watershed are indicated to exist in the sand and gravel soil areas of glacial outwash and ice contact origin. However, the towns within the watershed obtain water from ground water and surface sources outside the watershed area. There are no known wells to extract ground water within the watershed.

Ice contact deposits are highly variable in their distribution, grain size, and other physical properties, but, on the average, have a medium to high permeability and are favorable sources for ground water supply. Coarse, permeable ice channel deposits are buried beneath finer grained ice contact units in a few localities. Under these circumstances, the ground water in the channel deposits may be under artesian pressure with hydrostatic heads above ground.

Deposits of ice contact sand and gravel are the most important mineral resources in the watershed. Some of the igneous rock may be suitable for crushed stone and as building material.

The only notable mineral resources of economic importance produced in Norfolk County, as reported by the Bureau of Mines, United States Department of the Interior, are stone, sand, gravel, and clays ^{1/}. Potentially good sources of sand and gravel are indicated in about 25 percent of the soil areas of the watershed ^{2/}. Sand and gravel constitutes one of the North Atlantic Regions principal mineral resources. Figure C shows the surficial geology of the watershed.

Earthquakes in the northeastern United States ^{3/} have not been frequent or intense in comparison to other areas of the world. However, damaging earthquakes have occurred in the past, and some may be expected in the future. The Boston area has a higher frequency of damaging earthquakes than most other areas in the northeastern United States. Actual ground movement along old faults in the watershed is not anticipated even if an earthquake should occur in the Boston area.

^{1/} North Atlantic Regional Water Resources Study, North Atlantic Regional Water Resources Study Coordinating Committee, May 1972.

^{2/} Soils and Their Interpretations for Various Land Uses, (Walpole, Sharon), U.S. Soil Conservation Service in Cooperation with the Norfolk Conservation District, 1965 and 1966.

^{3/} Fred L. Fox, Seismic Geology of the Eastern United States, Association of Engineering Geologists Bulletin, Volume VII, pages 21-43.



Figure C SURFICIAL GEOLOGY ^{1/}

LEGEND



Recent alluvium and swamp deposits, including muck, peat, sand and fine gravel.



Ice contact and glacial outwash deposits consisting of poorly graded, bedded sand and gravel. These deposits are expressed in a variety of land forms including kames, kame fields, kame terraces, eskers, and outwash terraces.



Generally very dense silty sand with gravel, cobbles, and boulders. Locally, a looser unit of water-washed ground moraine is found overlying the more compact lodgement till. Glacial till probably underlies other surficial deposits in many places.

^{1/} Geology of the Norwood Quadrangle, Norfolk and Suffolk Counties, Massachusetts, U.S. Geological Survey Bulletin 1163-B, U.S. Government Printing Office, Washington, D. C., 1966.

Climate 1/

The climate is typical of lower coastal New England, with an average January temperature of 29°F. and an average July temperature of 71°F. The normal growing season of 176 days extends from about the first of May to mid-October. Average annual precipitation is about 43 inches with a runoff of 20 inches and is generally well distributed throughout the year. The average snowfall is 30 inches and may occur in appreciable amounts from November to April each year. The watershed experiences both tropical cyclonic storms originating on the continent and occasional coastal storms. Winter coastal storms often bring rainfall, in contrast to snow in the interior areas. Hurricanes can occur, particularly during the months of August, September, and October.

Land Use

Urban land is the major land use, covering about 609 acres or 48 percent of the watershed area. Other land use is: 587 acres (46 percent) forest land; 24 acres (2 percent) cropland; and 50 acres (4 percent) wetlands (excluding wooded wetlands). A portion of one part-time farming enterprise operates in the watershed. The urban development is located mostly in the lower or downstream portion of the watershed.

The lower portion of the watershed, because of its concentration of urban development, has high runoff producing characteristics. The hydrologic condition of the remaining portion of the watershed is poor to fair and is largely determined by the forest cover which is predominant in this area.

During the preparation of this work plan it was learned that an existing 18 hole golf course (Walpole Country Club) located east of Diamond Pond had been sold. The 80-acre area will be used for condominium housing with the retention of a 9-hole course. A new 18 hole course and country club is to be developed on about 120 acres of land which is presently about 80 acres of forest land and 40 acres of abandoned orchard. This new course will border the land acquired for the planned multiple-purpose structure site on the south and east.

Flood plain land use along Diamond Brook consists of about 50 acres of urban, 30 acres of water surface, and 50 acres in other uses, mostly woodland.

The trend of expanding urbanization indicates that most land will eventually be converted to urban uses, except for town owned recreation and conservation lands including land related to the proposed reservoir, and flood plain and other areas that may be publicly acquired or otherwise restricted in use. It is expected that a total of about 40 acres in scattered upland areas will be converted during the project installation period.

1/ Temperature and precipitation data from National Weather Service Records (formerly U.S. Weather Service).

Wetlands

There are 70 acres of wetlands within the watershed which are listed by type^{1/} and amount in Table A:

TABLE A - WETLANDS IN THE WATERSHED

Type	Area (Acres)
Type 2 - Inland Fresh Meadow	1
Type 5 - Inland Open Fresh Water	35
Type 6 - Shrub Swamp	14
Type 7 - Wooded Swamp	20
TOTAL	70

Wetlands comprise approximately 5.5 percent of the watershed area. However, within four miles of the watershed there are over 2,000 acres (about 9 percent of the area) of shrub swamps and wooded swamps in the headwaters of the Neponset River.

Surface Water Resources

The Diamond Brook drainage originates at Moose Hill in the town of Sharon. The stream flows northwesterly through a series of ponds and the business area of Walpole to its confluence with the Neponset River. The watershed is about 2.5 miles long and averages about 0.8 miles in width. The elevations in the watershed range from 130 feet above mean sea level at its outlet to 525 feet on Moose Hill.

From the stream's origin, about 300 feet east of Old Post Road and downstream to about 500 feet below Allen Pond, Diamond Brook is an intermittent stream. This distance is about 2,200 feet of which 600 feet is through Allen Pond. From 500 feet below Allen Pond to the Neponset River, the stream flows perennially for 7,780 feet of which 3,050 feet is through three manmade impoundments and 645 feet is through an underground conduit under the Walpole business area. Stream gradients through this area range from 0.007 ft./ft.

^{1/} Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C. 1956

downstream of the conduit to a maximum of about 0.029 ft./ft. downstream of Clark Pond. Channel widths range from 5 feet at Washington Street to about 8 feet downstream of the conduit. Through this reach, depths are a maximum of about 3 feet. Stream bottom substrata from Washington Street downstream to Memorial Pond consists largely of stones, gravel, and coarse sand, depending on the specific location within a pool. Riffles are primarily stony throughout this reach. Downstream of Memorial Pond to the conduit, the stream bottom contains gravel, coarse sand, and silt, since the gradient is much flatter. From the outlet of the conduit to about 200 feet downstream, the channel bottom contains stone, gravel, and coarse sand. For the remaining 200 feet to the confluence with the Neponset River, the stream bottom consists chiefly of fine sand and silts. The stream meanders gently throughout its length except for the area to be enlarged to provide an outlet for the existing and planned conduits. This section is essentially straight in alignment and shows evidence of being previously modified.

Diamond Brook flows almost totally through a red maple dominated woodland from its origin to Diamond Pond. Understory vegetation varies from very sparse to dense, depending on crown closure of the woodland. From Diamond Pond downstream to the entrance of the existing conduit through the business area of Walpole, the stream is within an urban area where vegetation along the channel is primarily grass with scattered shade trees. From the outlet of the conduit to the mouth of the brook, stream side vegetation is herbaceous plants, and scattered shrubs and trees.

There are 6 ponds in the Diamond Brook drainage area totaling about 35 acres in area, with maximum depths of less than 10 feet. Allen Pond in the flood pool of the multiple-purpose structure site is about 4 acres in area. The 3 ponds downstream of Washington Street on the main channel are Clark, Diamond, and Memorial Ponds. These ponds are about equal in area, averaging approximately 8 acres. Rainbow Pond and an unnamed pond just north of Diamond Pond are about 5 and 2 acres in area, respectively.

Vegetative cover bordering the 4 ponds on Diamond Brook is as follows: (Approximate percentage of shoreline footage)

Memorial Pond - 15 percent woody plants including red maple,
American elm, and arrowwood.
85 percent herbaceous plants including sedges,
cattail, and lawn grasses.

Diamond Pond

- Lower Pool -100 percent woody plants including red maple, gray birch, and white pine.
- Upper Pool -50 percent woody plants including red maple, gray birch, and white pine.
50 percent herbaceous plants including sedges, cattail, and lawn grasses.
- Clark Pond -50 percent woody plants including red maple, American elm, gray birch, and white pine.
50 percent herbaceous plants including sedges, cattail, and lawn grasses.
- Allen Pond -20 percent woody plants, including silky dogwood, speckled alder, and red maple.
80 percent herbaceous plants, including sedges, cattail, and timothy grass.

There are no stream gaging stations on Diamond Brook to provide data necessary for an adequate quantification of base flow. However, records exist for a low-flow partial-record station^{1/} for 1966 and 1967. Most measurements were taken at this station during periods of base flow when stream flow is primarily from ground water storage. The flows recorded are shown in Table B:

^{1/} Water Resource Data for Massachusetts, New Hampshire, Rhode Island, and Vermont. United States Department of the Interior, Geological Surveys, 1966 and 1967.

TABLE B - LOW FLOW MEASUREMENTS

Station Name	Location	Drainage Area Sq. Miles	Measurements	
			Date	Discharge (cfs) ^{1/}
Spring (Diamond) Brook at Walpole, Mass.	200 feet below outlet of Memorial Pond	1.84	8-16-66	.58
			9-12-66	.96
			5- 1-67	2.77
			8-17-67	1.47
			8-21-67	.79
			9- 6-67	1.68
			9-20-67	.98

Surface water quality in the watershed is adversely affected by residences and businesses located on sites with soils poorly suited for on-site septic systems. Data provided by the towns show approximately 350 residences and business properties having on-site sewage disposal systems. This represents about 30 percent of the residences and business properties within the watershed. Reference to the town operational soils reports indicates that about 15 percent of the on-site systems are located on soils having severe limitations for this use. These limitations are due to soils having a hardpan or compact layer which limits percolation and wet soils with a seasonally high water table.

Urban runoff containing pollutants (gas, oil, trash, animal wastes, etc.), also contributes to lower water quality, particularly during and following storms.

In 1967, all tributaries of the Neponset River were assigned a water quality classification of "B"^{2/} by the Massachusetts Division of Water Pollution Control. This classification or goal for future water quality was made in accordance with the tributaries anticipated uses and recognized that to achieve this desired water quality level all wastes discharged into the streams would require a high degree of treatment.

^{1/} cfs is an abbreviation for cubic feet per second. One cubic foot per second is about 7.48 gallons per second.

^{2/} Class B - Suitable for bathing and recreational purposes including water contact sports. Acceptable for public water supply with appropriate treatment. Suitable for agricultural, and certain industrial cooling and process uses; excellent fish and wildlife habitat; excellent aesthetic value.

Water quality data collected by the Massachusetts Division of Water Pollution Control shows that Diamond Brook, downstream from the Clark Pond inlet, does not meet the standard of class "B" water for dissolved oxygen content. This data also indicated that coliform count exceeds the allowable standard. However, coliform measurements over a longer time period are necessary to properly assess this parameter.

Table C gives the water quality standards^{1/} of class "B" water and the water quality parameters measured by the Massachusetts Division of Water Pollution Control on August 16 and 17, 1973. There were four sampling stations on Diamond Brook, (see Figure D for locations).

^{1/} Water Quality Standards and River Basin Classifications, Massachusetts Water Resources Commission, Division of Water Pollution Control, 1967.

TABLE C - WATER QUALITY MEASUREMENTS

WATER QUALITY PARAMETER	UNITS	STATE STANDARD FOR CLASS "B"	Measurements-August 16-17, 1973 ^{1/} SAMPLING STATION 2/			
			DIAMOND BROOK			
			1	2	3	4
1. DISSOLVED OXYGEN	mg/l	Not less than 75% of saturation during at least 16 hours of any 24-hour period and not less than 5 mg/l at any one time.	4.8	4.9	4.8	7.1
			5.0	4.9	4.3	7.1
			6.3	6.5	7.0	7.9
			7.1	7.2	7.4	7.3
2. COLIFORM BACTERIA (TOTAL)	per 10Cml	Not to exceed an average value of 1,000 during any monthly sampling period nor 2400 in more than 20% of samples examined during such period.	2500	1600	1000	1800
3. PH		6.5 - 8.0	6.8	7.3	6.5	6.5
4. TEMPERATURE	°F	No increase except where the increase will not exceed the recommended limit on the most sensitive receiving water use and in no case exceed 83°F in warm water fisheries, and 68°F in cold water fisheries, or in any case raise the normal temperature of the receiving water more than 4°F.	71.0	71.0	71.0	60.0
			70.0	70.0	69.0	60.0
			74.0	73.0	73.0	62.0
			73.0	74.0	72.0	59.0

^{1/} Dissolved oxygen and temperature were measured four times during the sampling period at about 6 hour intervals beginning at 4 to 5 a.m.

^{2/} Location of Sampling Stations:

1. Downstream from existing conduit outlet.
2. Upstream from existing conduit inlet.
3. Downstream from Clark Pond outlet.
4. Downstream from Old Post Road.

TABLE C (Continued) WATER QUALITY MEASUREMENTS

WATER QUALITY PARAMETER	UNITS		STATE STANDARD FOR CLASS "B"		Measurements-August 16-17, 1973 1/ SAMPLING STATIONS 2/			
					DIAMOND BROOK			
					1	2	3	4
5. TOTAL ALKALINITY	mg/l	See Note			21	20	15	12
6. BIOCHEMICAL OXYGEN DEMAND	mg/l	See Note			1.2	2.2	2.4	0.6
7. SUSPENDED SOLIDS	mg/l	See Note			6	3	12	3
8. AMMONIA as N	mg/l	Not to exceed an average of 0.5 mg/l as N during any monthly sampling period.			0.13	0.12	0.09	0.06
9. NITRATE as N	mg/l	See Note			0.1	0.1	0	0.4
10. TOTAL PHOSPHATE	mg/l	Not to exceed an average of 0.05 mg/l as P during any monthly sampling period.			0.06	0.04	0.03	0.02
11. IRON	mg/l	See Note			1.3	1.4	0.90	0.25

NOTE: Water quality parameters not specifically denoted shall not exceed the recommended limits on the most sensitive and governing water class use. In areas where fisheries are the governing consideration and approved limits have not been established, bio-assays shall be performed as required by the appropriate agencies.

1/ Dissolved oxygen and temperature were measured four times during the sampling period at about 6 hour intervals beginning at 4 to 5 a.m.

2/ Location of Sampling Stations:

1. Downstream from existing conduit outlet.
2. Upstream from existing conduit inlet.
3. Downstream from Clark Pond outlet.
4. Downstream from Old Post Road.

Diamond Brook

SAMPLING STATIONS

DIAMOND BROOK

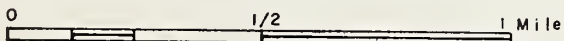
- ① DOWNSTREAM FROM EXISTING CONDUIT OUTLET
- ② UPSTREAM FROM EXISTING CONDUIT INLET
- ③ DOWNSTREAM FROM CLARK POND OUTLET
- ④ DOWNSTREAM FROM OLD POST ROAD



Figure D

LOCATION OF WATER SAMPLING STATIONS
DIAMOND BROOK WATERSHED
NORFOLK COUNTY, MASSACHUSETTS

U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



Plant and Animal Resources

In this small watershed, wildlife resources are enjoyed primarily by the people in a nonconsumptive manner rather than by consumptive forms of recreation. Songbird feeders and nesting boxes are common in the suburban residential neighborhoods throughout the watershed. Hunting is permitted in the towns of Sharon and Walpole. Hunting is permitted, with landowner permission, on about 300 acres or approximately 24 percent of the 1,270 acres in the watershed. The relative abundance of the principal game species within the watershed are shown in Table D, page 30.

Timber values of woodland are generally regarded in a similar non-consumptive manner. Landowners of forest land regard their woodland acreage as privately owned recreation and open space and place a higher value on walking through the woodland and looking at the trees than they do on any commercial sale of trees on the stump to a logging contractor. Consequently, the only logging conducted in the watershed is in preparing the land for development of residences or commercial enterprises. Land use trends in the watershed indicate that most lands will eventually be used for residential and commercial uses unless publicly owned or otherwise restricted.

Agricultural use of land is not a viable economic enterprise in the watershed and has not been for a long period of time. Pole to small sawlog woodland is dominant. Abandoned fields and other early forest succession stages are almost nonexistent.

None of the plant and animal species discussed in the following pages are designated as rare or endangered in Massachusetts. Consultation with the Massachusetts Division of Fisheries and Game and the United States Fish and Wildlife Service revealed that it is unlikely that any rare or endangered species occur in the watershed.

Plant and Animal Communities

Table E, on page 31 summarizes the plant communities by acres and the percent of the watershed area that each comprise. The general locations of various plant communities are shown on Figure E, page 32.

Following is a description of the plant communities and associated wildlife as identified in the watershed:

Forest Land

Five plant communities comprise the 587 acres (46 percent) of forest land in the watershed. These communities are: upland oak-hickory,

upland northern hardwood, mixed hardwood-softwood, coniferous, and the bottom land or wetland hardwoods.

1. Upland Oak-Hickory Community - This plant community comprises about 326 acres or 55 percent of the forest land in the watershed. White, red, and scarlet oak and shagbark hickory are dominant tree species and stands vary from young saplings to mature trees with pole size stands (5-11 inch diameter) making up the bulk of the acreage. Scattered pitch pine are often found in this community. Understory vegetation is scarce and consists of flowering dogwood, sassafras, and greenbrier. This community is most common on the dry, upland slopes such as those on Moose Hill. This plant community provides good habitat for gray squirrel and eastern chipmunk. This habitat will improve as oaks reach maturity providing an increased acorn crop and more numerous cavities for squirrel dens and songbird nesting. Habitat for woodland songbirds such as black-capped chickadee, white breasted nuthatch, blue jay, hairy woodpeckers, and downy woodpeckers is good and will also improve with maturity of the forest trees. Whitetail deer and eastern cottontail rabbit habitat is poor due to the stand size and sparsity of understory vegetation. Habitat for deer is also limited due to the small parcels of wooded areas intermingled with residential and commercial properties. Deer habitat (and deer movement) is located primarily in the 0.3 square mile area south of I-95 known as the Moose Hill area.

The following mammals find suitable habitat in this plant community: striped skunk, woodland jumping mouse, white-footed mouse, deer mouse, gray squirrel, eastern chipmunk, star-nosed mole, hairy-tailed mole, short-tailed shrew, opossum, whitetail deer (poor habitat), eastern cottontail (poor habitat), and gray fox (south of I-95).

Birds which can be found in this plant community for nesting or feeding or which use the community for feeding on a seasonal basis are: ruffed grouse, red-tailed hawk, yellow-shafted flicker, hairy-woodpecker, downy woodpecker, blue jay, black-capped chickadee, white breasted nuthatch, scarlet tanager, rufous-sided towhee, slate-colored junco, and black and white warbler.

Reptiles and amphibians which find suitable habitat are: the northern black racer, common garter snake, eastern milk snake, and American toad.

2. Upland Northern Hardwood Community - This community comprises about 16 acres or 3 percent of the forest land in the watershed.

Sugar maple, northern red oak, black cherry, American beech, white ash, white birch, basswood, quaking aspen, and red maple are all common members of this community. Stands vary from pole size to mature timber with small saw timber size stands (11-14 inch diameter) making up the majority. The soils on which this plant community is found are mostly moderate to well drained. Understory plants are scarce to abundant depending upon the amount of light getting through the forest canopy. The most common understory plants are: arrowwood, wild raisin, spicebush, greenbrier, sprouts of American chestnut, witch hazel, and sarsparilla.

Wildlife habitat for many species of mammals and birds depends largely on the density of the understory shrubs and herbaceous plants. The quality of wildlife habitat provided by this plant community varies from poor to good in the watershed with most of the acreage ranking as fair.

Mammals which find suitable habitat in this plant community of the watershed are: whitetail deer, gray fox, short-tailed weasel, opossum, short-tailed shrew, hairy-tailed mole, star-nosed mole, eastern cottontail (fair habitat), raccoon, eastern chipmunk, gray squirrel, northern flying squirrel, white-footed mouse, woodland-jumping mouse, and striped skunk.

Birds which often can be found in this plant community are: ruffed grouse, screech owl, red-tailed hawk, hairy woodpecker, downy woodpecker, yellow-bellied sapsucker, blue jay, common crow, black-capped chickadee, white breasted nuthatch, red breasted nuthatch, myrtle warbler, scarlet tanager, cardinal, rufous-sided towhee, slate-colored junco, and white-throated sparrow.

Reptiles and amphibians which find suitable habitat in this plant community are: common garter snake, northern black racer, eastern milk snake, and American toad.

3. Mixed Hardwood-Softwood Community - This community consists of mixed stands of deciduous and coniferous trees in varying amounts of each. This community comprises about 195 acres or 33 percent of the forest land in the watershed. It is a common community along the higher gradient reaches of Diamond Brook. White pine, eastern hemlock, pitch pine, red oak, sugar maple, white ash, American beech, American elm, basswood, and red maple are commonly found in this stand mixture. Stands vary from pole to mature aged, with small saw timber sized trees being the most common. Soils on which this plant community is found varies from moist to well drained. Understory plants

are scarce to abundant depending upon crown closure. Common understory plants are: arrowwood, honeysuckle, wild raisin, spicebush, greenbrier, sassafras, wild grape, witchhazel, shining clubmoss, sarsaparilla, wintergreen, and partridge berry.

The value of this community as wildlife habitat varies widely but overall is rated as fair in the watershed. Along Diamond Brook there are several areas where this plant community provides good habitat for songbird and cottontail rabbit since there is adequate light penetration for a high density of understory shrubs and herbaceous plants.

Mammals which find suitable habitat in this plant community of the watershed are: whitetail deer, gray fox, raccoon, opossum, short-tailed shrew, star-nosed mole, hairy-tailed mole, eastern cottontail, eastern chipmunk, gray squirrel, red squirrel, northern flying squirrel, white-footed mouse, woodland-jumping mouse, porcupine, and striped skunk.

Birds commonly (resident or seasonal resident) found in this community are: ruffed grouse, long-eared owl, red-tailed hawk, pileated woodpecker (occasionally observed), yellow-bellied sapsucker, hairy woodpecker, downy woodpecker, blue jay, common crow, black-capped chickadee, white-breasted nuthatch, red-breasted nuthatch, myrtle warbler, scarlet tanager, rufous-sided towhee, slate-colored junco, white-throated sparrow, Baltimore oriole, and evening grosbeak (winter).

Reptiles and amphibians which find suitable habitat in this community are: common garter snake, northern black racer, eastern milk snake, American toad, common newt (terrestrial stage), and spotted salamander.

4. Coniferous Community - This community comprises about 30 acres or 5 percent of the forest land in the watershed. Coniferous trees make up at least 80 percent of the stand composition and hardwoods comprise the remainder. The major species in this community are white pine, eastern hemlock, and pitch pine. Other species and particularly those in plantation stands are scotch pine, Norway spruce, red pine, and white spruce. Stands vary from sapling (less than 5 inches in diameter), to large saw-timber (greater than 14 inches in diameter), with small saw-timber stands making up the majority of the coniferous forest acreage. This plant community provides habitat for fewer species of wildlife than any other in the watershed. Understory plants are few or lacking altogether due to deep needle accumulations and a closed canopy which severely reduces light penetration. Understory plants that are occasionally found are greenbrier and honeysuckle.

Mammal species which find suitable habitat in this community are whitetail deer (protection during severe weather and escape cover), red squirrel, and porcupine.

Species of birds which find suitable habitat in this plant community are: screech owl (roosting cover), long-eared owl (roosting cover), blue jay, common crow (nesting and roosting), black-capped chickadee, slate-colored junco, starling (roosting), and pine grosbeak.

No species of reptiles or amphibians native to the watershed are known to prefer or depend upon this plant community.

5. Bottom Land Hardwoods Community - This community comprises about 20 acres or 3 percent of the forest land in the watershed. Dominant tree species are red maple, American elm, and an occasional black willow. Understory plants vary from scarce to abundant depending upon the amount of light penetrating the forest canopy. On most of the acreage of this plant community in the watershed there is adequate understory growth to provide good habitat for a large variety of wildlife species. Common understory plant species are: silky dogwood, speckled alder, witch hazel, greenbrier, honeysuckle, arrowwood, spicebush, and highbush blueberry.

This community occurs on very poorly drained soils in upland depressions. It also occurs along the flatter gradient reaches of Diamond Brook and is classified as a Type 7¹/ wooded swamp wetland.

Species of mammals which find suitable habitat in this plant community of the watershed are: raccoon, red-backed vole, whitetail deer, short-tailed weasel, opossum, eastern cottontail, northern flying squirrel, little brown Myotis, and eastern pipistrelle.

Birds which are commonly (resident or seasonal resident) found in this community are: woodcock, tufted titmouse, catbird, wood thrush, veery, ruby-crowned kinglet, cedar waxwing, brown thrasher, yellow warbler, myrtle warbler, northern waterthrush, common grackle, American redstart, common redpoll (winter), red crossbill (winter), eastern green heron, and tree swallow. In spring when depressions and streamside flats are flooded, this wetland type is occasionally used for resting and feeding by black, wood and mallard duck.

¹/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

Reptiles and amphibians which find suitable habitat in this plant community are: common garter snake, eastern ribbon snake, wood frog, spring peeper, spotted salamander, Jefferson salamander, and gray treefrog.

Open Land (Agricultural)

Only one vegetative cover type - grassland is identified in this land use. A total of 24 acres of hayland found mostly on one part-time farm operation comprises about 2 percent of the watershed area. Although the primary purpose of this acreage is to provide forage for livestock, there are also benefits to wildlife in the form of providing habitat for species which require open grassy areas and habitat diversity for species which use grassy vegetation for some particular life function such as courting, nesting, or as an occasional or preferred feeding area. Woodland surrounds most of this grassy agricultural land creating approximately 4000 feet of valuable wildlife "edge". This edge provides an interface between escape cover and a feeding area and is a preferred habitat condition of many species of mammals and birds.

Species of mammals in the watershed which find suitable habitat within the grassland cover type or at the edge along its wooded margin are: whitetail deer (occasionally seen feeding the hayland acreage on Moose Hill, (south of I-95)), woodchuck (fields and edge), red fox (hunts mice in field and edge), short-tailed weasel (edge), short-tailed shrew (field and edge), star-nosed mole (field and edge), eastern cottontail rabbit (especially edge), meadow vole (field), meadow-jumping mouse (edge), striped skunk (edge), and eastern chipmunk (edge).

Species of birds which find suitable habitat within the grassland cover type or at the wooded edge are: yellow-shafted flicker (edge), catbird (edge), robin, sparrow hawk (hunts over field), red-tailed hawk (hunts over field), common grackle, red winged blackbird, cowbird, English sparrow, eastern meadowlark, mourning dove, blue jay, field sparrow, eastern kingbird, ruffed grouse (edge), eastern phoebe, rufous-sided towhee (edge), song sparrow (edge), ringneck pheasant (scarce in the watershed), common goldfinch, and starling.

Reptiles and amphibians which find suitable habitat within or around the fields are: eastern milk snake, eastern smooth green snake, northern black racer, eastern garter snake, and American toad.

Wetland

Four wetland plant communities are identified in the watershed which total 70 acres. Twenty acres of this total is described under Forest Land as the bottom land hardwoods community. The other three communities are the shrub swamp of which there is 14 acres; inland open fresh water (35 acres) and inland fresh meadow (1 acre). In total, wetland acreage comprises about 5 percent of the land area in the watershed.

1. Inland Fresh Meadow Community - This wetland plant community constitutes the Type 2 wetland as described in Circular 39 1/. One acre of this wetland type is located along Diamond Brook in the vicinity of its confluence with the Neponset River. The dominant vegetation in this community is purple loosestrife, various species of sedges (Carex), and cattail. Other plants scattered throughout this community are: goldenrod, slender nettle, Japanese knotweed, cinnamon fern, pokeberry, nightshade, and widely scattered clumps of arrowwood, wild spirea, silky dogwood, elderberry, red maple, and American elm. This community provides good habitat for a variety of wildlife.

Mammals which find suitable habitat in this plant community of the watershed are: muskrat (especially adjacent to the stream channels), mink, raccoon (especially where this type borders on adjacent woodland as in the Neponset River flood plain), red backed vole, meadow vole, meadow-jumping mouse, and little brown Myotis.

Birds found in this community are: ringneck pheasant (low numbers in the watershed), American bittern, mallard duck (feeding areas during spring), black duck (feeding areas during spring), green-winged teal (feeding areas during spring), red-tailed hawk, Wilsons snipe, tree swallow, catbird, yellow warbler, yellow-throat warbler, red-winged blackbird, swamp sparrow, and common grackle.

Reptiles and amphibians found in this plant community are: snapping turtle (in and along stream channel), common garter snake, eastern ribbon snake, northern water snake (along stream edge), spring peeper, green frog, leopard frog, pickerel frog, and wood frog.

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C. 1956.

2. Shrub Swamp Community - This wetland plant community totals 14 acres in the watershed and constitutes the Type 6 wetland as described in Circular 39 ^{1/}. In the watershed, this community is found in the flood pool of the planned structure (8 acres) and in an area south of Memorial Pond. The vegetation in this community is: silky dogwood, arrowwood, spicebush, highbush blueberry, and speckled alder.

The little brown Myotis, eastern pipistrelle, and hoary bat find suitable feeding areas over this plant community during late evening and night hours. These flying mammals feed upon the flying insects which are usually prolific over this plant community.

Species of birds which find suitable habitat in this plant community are: woodcock (around margin), tufted titmouse, catbird, wood thrush, veery, ruby-crowned kinglet, cedar waxwing, brown thrasher, parula warbler, yellow warbler, myrtle warbler, black-poll warbler, and common redpoll.

Reptiles and amphibians of the watershed which find suitable habitat in this plant community are: northern water snake (adjacent to open water), wood turtle, common garter snake, ribbon snake, spring peeper, leopard frog, pickerel frog, wood frog, gray treefrog, spotted salamander, and Jefferson salamander.

3. Inland Open Fresh Water Community - This wetland plant community totals 35 acres in the watershed and constitutes the Type 5 wetland as described in Circular 39 ^{1/}. This wetland community includes the four ponds on Diamond Brook, Rainbow Pond, and three other small ponds. Common plants found in this community of the watershed are: pondweeds (Potamogeton), coontail, cattail, sedges, and waterlily.

This plant community often provides good waterfowl brood rearing habitat around its margin. However, in this watershed the urbanization adjacent to most of the ponds and human activity severely limits the use of the ponds for brood rearing by wild ducks. Semi-domestic mallards are present on the ponds on Diamond Brook and move back and forth between these ponds and other ponds outside the watershed. Light use is made of most of the ponds by waterfowl for resting and feeding during spring and fall migration.

The most valuable acreage of Type 5 ^{1/} wetland in the watershed is four acre Allen Pond. Black, wood, and mallard duck prefer this wetland for resting and feeding during spring and fall migration since it is quite remote from residences and human activity. In 1973, a pair of Canada geese reared a small brood of goslings at this pond.

^{1/} Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956

Mammals which find suitable habitat in or around this wetland type are: muskrat, and little brown Myotis, eastern pipistrelle, and hoary bat which feed on insects over the pond during evening and night hours.

Birds which find suitable habitat in or around this wetland plant community are: great blue heron, eastern green heron, kingfisher, green-winged teal, mallard duck, black duck, wood duck, tree swallow (feed on insects over pond), catbird, yellow-throat warbler, barn swallow (feed on insects over pond), chimney swift (feed over pond), red-winged blackbird, and Canada goose (limited to Allen Pond).

Reptiles and amphibians which find suitable habitat in or around this wetland type in the watershed are: snapping turtle, spotted turtle, painted turtle, northern water snake, common garter snake, ribbon snake, spring peeper, bullfrog, green frog, leopard frog, common newt (when larvae and adults), pickerel frog, American toad, wood frog, and spotted salamander.

Other Plant Communities and Habitats

Much of the 609 acres of urban land and especially suburban residential land has grassy areas with scattered ornamental shrubs and trees which provide nesting sites for songbirds. Landowner interests in songbirds and other wildlife often lead to setting out artificial feeders and nesting boxes and planting certain shrubs which can and do increase the amount of wildlife in urban areas despite the perils of cats, dogs, and people. Some very good wildlife habitat occurs in this somewhat artificial way especially in suburban areas with low density housing.

Some specific habitats occur in the watershed's urban and suburban areas which seldom occur in more rural areas. Some of these habitats are worthy of note and include the nighthawk nesting habitat provided by flat roofed buildings in the business area of Walpole. Nighthawks nest and rear their young on the roofs of these buildings and feed on insects over the downtown area during the cooler evening hours when the young birds do not require shading from the sun. The steep banks found in sand and gravel pits provide nesting areas for bank swallows in the suburban areas. Rock doves and English sparrows nest in crevices and shelves provided by the architectural style of older buildings in the business area.

Most of the land in the watershed is providing habitat for one or more species of wildlife. However, the long term trend is that fewer and fewer species will continue to find their particular habitat requirements in the watershed area. This continuous reduction in the quantity and diversity of wildlife habitats is largely the result of increasing urbanization and is the most significant factor affecting wildlife in the watershed area.

Fisheries Resources

No stream sport fishery exists in Diamond Brook. Native species include blacknose dace and common white sucker. High summer water temperatures and low dissolved oxygen levels in summer make the stream unsuited to a trout fishery.

For information on streamside vegetation and streambed material see the Physical Data section entitled Surface Water Resources.

All four of the manmade ponds on Diamond Brook contain self-sustaining warm water fisheries. Memorial, Clark and Diamond Ponds support a population of brown bullhead, bluegill sunfish, yellow perch, largemouth bass, blacknose dace, and common white sucker. Largemouth bass to a size of four pounds are reportedly caught in Memorial Pond. Clark Pond is stocked annually with trout by the Walpole Conservation Commission as a put and take fishery. Allen Pond contains a population of brown bullhead, bluegill sunfish, and largemouth bass.

Public Access to Existing Fish and Wildlife Resources

The town of Walpole owns and permits public access to eight acre Memorial Pond and eight acre Clark Pond for fishing, nature study, wildlife observation and ice skating.

There is no publicly owned land to provide access to Diamond Pond and Allen Pond. However, some public fishing use is allowed on Diamond Pond.

No stream sport fishery exists in Diamond Brook, consequently, there is no demand for stream access for fishing. Since the stream flows largely through residential areas the primary uses made of the songbirds and other wildlife found along the channel are for nature study and wildlife observation. Since these activities are nonconsumptive and have little to no adverse effects on wildlife or private property, access has not been a problem.

Of the 661 acres of open space lands in the watershed, approximately 300 acres of predominantly forest land is available (with landowner permission) for hunting. This available acreage is the area remaining beyond the legal hunting distances from occupied dwellings and public roads. The entire 661 acres of open space lands is available (with landowner permission) for nonconsumptive uses of the wildlife resources. No publicly owned hunting areas are present in the watershed.

TABLE D - RELATIVE ABUNDANCE OF PRINCIPAL GAME SPECIES

Species	Average Habitat Value	Abundance (Spring Population)
Deer	Poor	2 to 3 per square mile of suitable habitat. Approximately 0.3 square miles of suitable habitat in the watershed south of I-95.
Eastern Cotton- tail Rabbit	Fair	1 to 2 per 10 acres of suitable habitat. Approximately 500 acres of suitable habitat. Also, fairly common in residential areas of the watershed.
Gray Squirrel	Good	1 to 2 per 3 acres of forest land. Approximately 550 acres of suitable forest habitat. Also, common in recreation and suburban residential areas in the watershed.
Ruffed Grouse	Poor	1 per 35 acres of forest land. About 500 acres of suitable habitat.
Woodcock	Fair	Native breeding population; 4 per 100 acres of shrub and tree cover in the watershed. About 40 acres of particularly suitable habitat. Seasonal highs during migration in April and October.
Waterfowl (primarily black, mallard, and wood duck)	Fair	Low breeding population on existing ponds and marshes due largely to close proximity of residences. Semi-domesticated mallards are fairly common on three of the man-made impoundments on Diamond Brook. Seasonal highs during migration in spring and fall.

TABLE E - SUMMARY OF PLANT COMMUNITIES IN THE WATERSHED

Cover Type	Plant Community	Acres	Percent of Watershed
<u>Forest Land</u>	Upland Oak-Hickory	326	25.7
	Upland Northern Hardwood	16	1.2
	Mixed Hardwood-Softwood	195	15.3
	Coniferous	30	2.4
	Bottom Land Hardwoods	20	1.6
<hr/>			
	TOTAL OF FOREST LAND:	587	46.2
<u>Open Land</u> (Agricultural)	Grassland	24	1.9
	<hr/>		
	TOTAL OF OPEN LAND:	24	1.9
<u>Wetland</u> ^{1/}	Inland Fresh Meadow	1	0.1
	Shrub Swamp	14	1.1
	Inland Open Fresh Water	35	2.7
	<hr/>		
	TOTAL OF WETLAND:	50	3.9

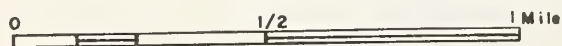
^{1/} 20 Acres of wooded swamp is included under Forest Land as the bottomland hardwoods community.



Figure E

PLANT COMMUNITIES MAP^{1/}
 DIAMOND BROOK WATERSHED
 NORFOLK COUNTY, MASSACHUSETTS

U.S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE



^{1/} does not include wetland plant communities; these areas are too small to be illustrated on a map of this scale

Economic Resources

Except for approximately 60 acres in several town-owned parcels, watershed lands are in private ownership. The trend of expanding urbanization indicates that most of this privately owned land will eventually be converted to urban uses unless publicly acquired, restricted, or managed. Most undeveloped land is zoned for residential use.

There is a total of about 24 acres of agricultural land within the watershed, most of which is hayland used to provide forage for beef cattle.

Land values based on recent sales for residential, commercial, or industrial development are \$2,500 to \$10,000 per acre. There appears to be little difference in price between upland and flood plain land values. Price differences appear to result from nearness to access and other developments, such as service areas, shopping centers, and existing utilities.

An excellent network of streets and secondary roads provides access within the watershed and to the major highways traversing the area which are U.S. Route 1 and I-95. The Penn Central Railroad serves as a vital transportation link for the area's industries.

The watershed is within the Boston Standard Metropolitan Statistical Area (Figure F) as defined by the U.S. Bureau of the Census. The economy of the watershed is keyed to that of this metropolitan area.

A number of large industries along the Neponset River adjacent to the watershed provide employment for many of the watershed residents. Others, particularly those residents in the newer suburban areas, commute to nearby cities and towns for employment.

Within Walpole, which is the center of economic activity for the watershed, manufacturing provides over two-thirds of the employment. Wholesale and retail businesses provide a major portion of the remaining employment.

The Comprehensive Plan for Walpole (1971)^{1/} summarized the area's economic status as follows: "Walpole's location near major centers of employment and population, combined with a well established employment base, good public services and utilities and a choice of both public and private transportation, seems likely to maintain the town's economic health and assure it a large share of any regional economic expansion."

^{1/} Comprehensive Plan Study, Walpole, Massachusetts, 1971,
Charles E. Downe, Planning Consultant.



LEGEND :



BOSTON SMSA



DIAMOND BROOK WATERSHED

Figure F

BOSTON STANDARD METROPOLITAN STATISTICAL AREA

Recreational Resources

Numerous major recreational areas that provide intensive recreational opportunities exist along the Atlantic Coast close enough to permit same-day return. Limited opportunities exist within the watershed for short-term daily recreational uses, such as hiking, picnicking, nature study, and other forms of passive recreation. The primary factor which limits such recreational opportunities is the scarcity of large tracts of open space available for public use.

The planned fish and wildlife pool, of the multiple-purpose structure, and adjacent public land will provide an opportunity for nature study, wildlife observation and other forms of passive recreation. The town operational soils report for Walpole 1/ shows soils to be suitable for the planned uses.

Recreational opportunities are provided by town owned lands, which permit public access to Memorial Pond and Clark Pond. Memorial Pond provides winter ice skating, spring, summer, and fall fishing for warm water species and a limited opportunity for nature study and wildlife observation. Clark Pond provides warm water fishing and is stocked annually by the Walpole Sportsman's Association to provide trout fishing.

No cold water sport fishery exists in Diamond Brook due to high temperature and low dissolved oxygen of the stream in late summer. Trout are not stocked in the brook or ponds by the state fish and game agency because of these water quality limitations. No warm water fishery exists in the brook due to its small size and low summer flow.

Potential small game hunting opportunities exist on about 300 acres of watershed land, located mostly in the upstream portion of the watershed south of I-95. This acreage would provide sufficient range for about 38 hunters 2/ at any one point in time. Portions of the 300 acres is posted requiring hunters or other recreationists to obtain landowner's permission prior to entry.

1/ Soils and their Interpretations for Various Land Uses, (Walpole, Sharon) U.S. Soil Conservation Service in Cooperation with the Norfolk Conservation District, 1965 and 1966.

2/ Based on data in Outdoor Recreation Space Standards, Bureau of Outdoor Recreation, United States Department of the Interior, U.S. Government Printing Office, Washington, D.C., March 1970

No opportunities are provided for swimming in Diamond Brook. Water quality data indicates that a health hazard exists for this activity. The total coliform count exceeds the Massachusetts Department of Public Health's standard for this use.

Archaeological, Historical and Unique Scenic Resources

The Massachusetts Historical Society and the State Archaeologist have advised the Soil Conservation Service that their listings show no sites of historical or archaeological value in the areas that would be affected by the planned structural measures. In addition, a survey has been carried out by a qualified archaeologist. This survey shows that no archaeological resources will be adversely affected by project measures. A copy of the survey report is included as an appendix to the environmental impact statement for this project.

Soil, Water & Plant Management Status

The Norfolk Conservation District is the legally constituted unit of State government that administers soil, water and related conservation work as specified in Chapter 21, of the Massachusetts General Laws. Technical assistance is provided to individual landowners, towns, and others through working agreements with the Soil Conservation Service and other federal and state agencies. Conservation plans have been developed for the one farm with a portion within the watershed, and for a country club.

Technical assistance provided through the District to the towns in developing town operational soils reports ^{1/} and town natural resource inventories is of particular importance in this developing urban watershed. Town operational soils reports which contain an inventory of soils with interpretations for various uses have been prepared for Walpole and Sharon by the Soil Conservation Service. Town natural resource inventories also have been developed for Walpole and Sharon. This is an inventory and appraisal of resource potentials related to the town's specified objectives. The town of Walpole has utilized its natural resources inventory to develop a town conservation plan and has correlated it with the town master plan.

Assistance to towns in developing and utilizing a natural resource inventory is provided through the District by an interagency Natural Resources Technical Team. Agencies represented include: the Massachusetts Department of Natural Resources through its Division of Forests and Parks and Division of Conservation Services, the Massachusetts Division of Fisheries and Game, the Cooperative Extension Service, and the Soil Conservation Service. Other agencies also participate, depending on local problems and needs.

^{1/} Soils and their Interpretations for Various Land Uses, (Walpole, Sharon). U.S. Soil Conservation Service in Cooperation with the Norfolk Conservation District, 1965 and 1966.

Adequate forest fire protection is provided by the Massachusetts Department of Natural Resources, Division of Forests and Parks, in cooperation with the U.S. Forest Service, through the Clarke-McNary Cooperative Fire Control Program and by the local fire departments. Other available federal-state forestry programs include: Cooperative Forest Management, Cooperative Forestation, and Cooperative Insect & Disease Control.

This watershed is within the Neponset study area of the Massachusetts Water Resources Study (Type IV River Basin) and also, in the Southeastern New England Study (Level B River Basin), which are presently under way.

The Comprehensive Plan for Walpole (1971)^{1/} includes the following objectives that will likely affect land use and management within the Walpole portion of the watershed:

1. To Preserve and Improve the Natural and Visual Environment of the Town

This objective recognized the need to preserve the natural assets which make Walpole attractive, to enhance the visual character, form and features of both the natural and manmade features of the community and to reduce unsightly conditions in the town.

2. To Provide for the Proper and Orderly Growth of the Town

This objective recognizes the need to reach realistic decisions about the future use of land, to provide for a variety of development (residential, business and industry) in order to arrive at a desirable "balance," and at the same time to provide for a proper distribution and location of land use by kind and intensity.

^{1/} Comprehensive Plan Study, Walpole, Massachusetts, 1971,
Charles E. Downe, Planning Consultant.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

Land use and treatment problems are primarily associated with future use and development. Expanding urbanization has made it necessary that wise land use decisions be made and appropriate treatment be applied to enhance and preserve open space, fish and wildlife resources, and other values necessary for a quality environment. As urban development and associated service facilities encroach on present rural areas, there is an increasing need for technical assistance to planning bodies, developers and individuals to assure orderly growth compatible with the proper use of natural resources.

Floodwater Damage

This watershed has experienced damaging floods in 1936, 1938, 1955, and 1968. Flooding caused by Hurricane "Diane" in August 1955 was the most severe. Rainfall during the August 1955 storm was a maximum of about 11.5 inches for a 24-hour period and a total of 15 inches for the two-day storm period.

The area of flood plain which is subject to flooding from a 100-year frequency event amounts to about 100 acres along Diamond Brook. Residential, commercial, and related development occupies about 50 acres in the lower reaches while the remaining flood plain acreage is largely under forest cover and water surface.

As forest and grassland are replaced by urbanization, the rate of runoff will increase, thus increasing flood stages and resulting floodwater damages. Proper planning, management, and controls are necessary to minimize these effects of urbanization.

The major damage area is in Reaches 1 and 2, the business section of Walpole, where the brook has been channeled into a conduit. Adjacent to and over this conduit, a two-story commercial building, supermarket, shopping center, and paved parking area have been developed.

The combination of uncontrolled runoff and inadequate capacity of the conduit causes serious flooding problems. These problems are further aggravated by debris collecting on the inlet trash rack of the conduit. Filling in the flood plain for playgrounds, parking lots, and commercial expansion has increased the flood hazard.

The average annual direct and indirect damages are \$12,010 to residences, \$56,490 to commercial properties, and \$15,020 to roads and bridges. Flood flows exceeding the magnitude of a 3 to 5 year frequency event cause damages along Diamond Brook. The 1968 flood was estimated at between a 10 and 25 year frequency event. A recurrence of the 1968 storm at this time would cause damages of about \$180,000.

In the August 1955 flood, roads, bridges, 14 houses, 1 school and 42 commercial establishments were flooded by the waters from Diamond Brook. The brook overtopped the headwall of the conduit and flowed through the business section (Reaches 1 and 2) of the town of Walpole (see photographs, pages 40 and 41). Transportation was disrupted and public health and safety were jeopardized. Relatively minor damages occurred, principally to roads and bridges, upstream of Reaches 1 and 2.

Under present conditions, the August 1955 storm would produce flood peaks on Diamond Brook about 60 percent greater than a 100-year frequency event. Damages totalling about \$1,140,000 would be caused to roads, bridges, 15 residences, 1 school, and 45 commercial properties.

Erosion and Sediment Damage

The present state of vegetative cover in the watershed keeps erosion and sediment damages within acceptable limits. However, most of the forest and grassland will eventually be developed for urban uses. During urban development, proper planning, management and control measures are necessary to control soil loss and sedimentation which could adversely affect water quality, fish and wildlife habitat, and generally reduce the quality of the environment.

There is a scattering of small (one-half acre or less) sources of erosion over the watershed area. They are the result of various forms of urban construction. Erosion is primarily of the sheet and rill type. Erosion that does occur is the result of construction on sites after removing vegetative cover. The estimated average annual erosion rate for such areas is 18 tons per acre. The severity of erosion that occurs on any one area is dependent on a number of factors which include: slope, rainfall intensity, season of the year, and the time interval until revegetated or surfaced. There is little evidence of eroded material reaching stream channels. Impoundments on Diamond Brook show little accumulation of sediment.

Municipal and Industrial Water Supply Problems

A study^{1/} conducted in 1967 for the town of Walpole by a consulting firm concludes that: (1) the present water supply for the town of Walpole is inadequate, (2) future water supply would most economically be provided by ground water sources, and (3) projected requirements by 1990 will exceed the potential ground water supply. The population to be served by 1990 is estimated to be 39,900 in the town of Walpole. The Northeastern Water Supply Study, authorized by Public Law 89-298, suggests that future water needs be derived from the Metropolitan District Commission which serves the water needs of the Boston area.

^{1/} Comprehensive Plan Study, Walpole, Massachusetts, 1971
Charles E. Downe, Planning Consultant.





East Street, below Main Street, on
August 19, 1955



East and Main Streets, shortly after the
flood peak on August 19, 1955.



Behind East Street at the culvert inlet,
on August 19, 1955.



Along East Street, on August 19, 1955,
the day of the "Diane" flood.

Providing water storage for municipal water supply was considered for the multiple-purpose structure site. However, the small drainage area and limited storage of the site ruled out this possibility and an alternative site with greater storage capacity was not available.

Recreation Problems

The future water quality classification assigned to Diamond Brook is Class B. The stream does not presently meet this standard, and consequently the recreational use of the stream and its existing impoundments is limited to activities other than water contact types.

There is no public access to Diamond and Allen Ponds. Also, as rapid urbanization continues, a decreasing amount of existing open space will be available to the public for outdoor recreation. If the towns continue to have a high interest and active programs for acquiring open space for outdoor recreation, this problem will be lessened.

Plant and Animal Resource Problems

Lack of agricultural land, predominance of pole size forest stands and lack of habitat management combine to provide large blocks of similar cover with a limited diversity of plant and animal communities.

Wildlife habitat is a secondary use of most of the land in the watershed, and urbanization is resulting in an estimated average loss of 8 acres of this land per year.

Water Quality Problems

Approximately 50 residences and business properties with on-site sewage disposal systems have been constructed on soils with severe limitations for on-site sewage systems. When on-site sewage disposal systems are installed on such soils, failure of the system usually occurs. This failure can result in the leachate finding its way into water courses and subsequently lowering the water quality of the receiving water. This situation may be occurring in Diamond Brook as indicated by high coliform counts (See Table C, pages 17 and 18).

PROJECTS OF OTHER AGENCIES

The works of improvement proposed in this plan will contribute to the overall development of water resources in the Neponset River Basin with no apparent conflict with any existing or proposed works of improvement. The Massachusetts Water Resources Commission is currently conducting a study of the Neponset River Basin to establish quantitative relationships between the effects of urban development on the wetland and flood plains of the basin and the increases in flood stages resulting therefrom. Information developed in the study for development of the work plan will be incorporated in the Neponset River Basin Study.

In addition, flood insurance is now available to watershed residents through the National Flood Insurance Program administered by the Department of Housing and Urban Development.

PROJECT FORMULATION

The application for assistance was submitted to and approved by the Massachusetts Water Resources Commission acting for the Governor of the Commonwealth. Through this procedure, the intent of the sponsors to develop a project plan was made known to concerned state resource agencies. Concerned federal agencies were also advised of the sponsors' intent. Development of the project plan was facilitated by consultation with the concerned federal, state, and local agencies through correspondence, meetings and numerous contacts. As a sponsor of the project, the town of Walpole was involved throughout the planning process. In addition to the Board of Selectmen, appropriate town boards were involved through meetings, correspondence, and personal contacts.

Interested members of the local public were timely informed through numerous newspaper articles during the planning stage. Upon completion of the tentative plan, a public information meeting was held for affected property owners and the general public. Interested state and local agencies were also represented. Draft copies of the plan were provided to interested participants and comments were invited. Comments of those who responded were considered by the planning team and sponsors, and were included in the plan as appropriate.

Based on preliminary project plans, the U.S. Fish and Wildlife Service provided an appraisal of the (a) opportunities for improvement of fish and wildlife resources and (2) potential project effects on fish and wildlife.

The fish and wildlife feature of the multiple-purpose structure was developed in cooperation with the Massachusetts Division of Fisheries and Game.

Objectives

The objectives of this project as agreed to by the sponsors and the Service are to:

1. Provide protection to the major residential and commercial areas from floodwater caused by a storm equivalent to the storm of record (August 1955).
2. Provide recreation and improve fish and wildlife habitat and open space values.
3. Achieve wise use and management of land, water and related natural resources consistent with a balance of economic use and the protection and improvement of environmental quality.

Environmental Considerations

The intent during project formulation was to achieve the desired effects, as expressed by the project objectives, and to avoid or minimize adverse effects to the extent practicable.

Alternatives

Alternative actions have been considered with particular attention to those actions that might avoid some or all of the adverse environmental effects of the planned project. These alternatives are: land treatment; land treatment and a floodwater retarding structure; land treatment and channel work; and no project.

Land Treatment

This alternative would consist of the land treatment phase of the planned project which includes accelerated land treatment to supplement the ongoing land treatment program. Technical assistance would be provided to town boards, community leaders, and others for preparing town resource inventories and plans, reviewing urban development plans and planning and applying treatment measures on land requiring treatment. Essential conservation treatment would be applied to all watershed lands. About 291 acres would receive treatment to achieve the desired level of protection or improvement. The remaining lands would receive treatment to supplement that which has already been applied. The estimated cost of this alternative is \$81,300.

A reduction in erosion and sediment from areas undergoing urban development would result from this alternative. The adverse effects of urban development on the hydrologic condition of the watershed, fish and wildlife habitat and other natural resources would be reduced. Improvement of recreation, fish and wildlife and environmental values would also be achieved.

This alternative would not meet the selected objective of the sponsors for providing flood protection of the major residential and commercial areas from a storm equivalent to the August 1955 event, nor would it provide a 17-acre pool and its recreation, open space and fish and wildlife values. This alternative would, however, avoid the adverse environmental effects of the planned project structural measures.

Land Treatment and Floodwater Retarding Structure

The land treatment phase of this alternative would be the same as included in the planned project which includes accelerated land treatment to supplement the ongoing land treatment program. The costs, benefits, and effects would also be the same.

A single-purpose reservoir structure would be constructed at the site of the multiple-purpose structure included in the planned project. The structural features and size would be essentially the same as the multiple-purpose structure. The dam would be about one foot lower in height without the storage for fish and wildlife. The principal spillway would have an opening at its base to permit the passage of normal streamflow. Only temporary storage for floodwater would be provided within the reservoir area.

The cost of this alternative would be about \$589,200.

The level of protection that would be provided for the major damage area (business section of Walpole) is such that damaging floods would occur from a 25-year frequency event.

The objective of the sponsors for flood protection would not be met by this alternative.

About 45 acres of land would be committed to this alternative. There would be a temporary increase of noise, air pollution, erosion, and sedimentation caused by construction activities.

This option would not include the fish and wildlife pool nor the channel work of the planned project.

Adverse environmental effects of the planned project which would be avoided if this alternative were implemented, would include (1) the reduction of 12 acres of Type 7 ¹/₂ wetland and one acre of Type 2 ¹/₂ wetland resulting from the fish and wildlife pool and channel work; (2) the reduction of 700 feet of perennial stream habitat and 400 feet of intermittent stream habitat resulting from the fish and wildlife pool; and (3) increase downstream water temperature 2° to 4° F by the fish and wildlife pool.

Land Treatment and Channel Work

This alternative consists of the same land treatment phase (accelerated plus ongoing program) and channel work included in the planned project. All costs, benefits, and effects of the land treatment phase would also be the same.

¹/₂ Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

The total cost of this alternative would be about \$507,000.

Flood protection would be provided for the major damage areas of Walpole (Reaches 1, 2, and 3, from the railroad bridge upstream to Diamond Street). A 100-year level of protection would not quite be achieved. However, damages from a 100-year frequency flood would be reduced by about 80 percent. The areas upstream (Reaches 4, 5, and 6) would receive no protection from this alternative.

The channel work would cause temporary interruptions to traffic flow and services provided by water, sewage, drainage, telephone, and electric utilities. There would be temporary increases in noise, air pollution, turbidity and sediment. A reduction in the quality of the aquatic habitat in 400 feet of existing channel would result from its enlargement. The channel work would induce higher peak flows downstream and would reduce Type 2 1/ wetland habitat by one acre. This alternative does not include the multiple-purpose structure of the planned project.

Adverse environmental effects that would be avoided if this alternative were implemented, would include (1) the reduction of 12 acres of Type 7 1/ wetland resulting from the fish and wildlife pool; (2) the reduction of 15 acres of forest resource and associated wildlife habitat resulting from clearing for the dam, spillway and borrow area; (3) the occasional temporary loss of 16 acres of wetland wildlife habitat and 14 acres of woodland wildlife habitat resulting from floodwater storage; (4) the reduction of 850 feet of perennial stream habitat and 400 feet of intermittent stream habitat resulting from the dam and fish and wildlife pool; (5) the increase of water temperature downstream of the fish and wildlife pool by 2° to 4° F.; and (6) the temporary increase of noise, air pollution, erosion, and sedimentation resulting from construction of the multiple-purpose structure.

No Project

If no project is chosen there would be no concerted activity directed toward solving the water and related land resource problems that exist in the watershed. Existing conditions, needs and trends, as described in the "ENVIRONMENTAL SETTING" section of this report, would continue.

1/ Wetlands of the United States, Circular 39, U.S. Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

The ongoing land treatment program of the Norfolk Conservation District would continue to be applied to the lands in the watershed. However, accelerated assistance would not be provided toward minimizing the adverse effects of urban development on the area's natural resources and environmental quality.

Flood plain zoning bylaws enacted by Walpole through town meeting action, as authorized by the Massachusetts Zoning Enabling Act, would be enforced to prohibit future development which would be subject to significant economic flood losses or jeopardize human health and safety. Filling and placing of other obstructions in the course of flood flows would also be prohibited where such obstructions would contribute to higher flood flows and possible water course changes that would increase damages to existing property.

Flood insurance would be made available through the federally subsidized National Flood Insurance Program administered by the Department of Housing and Urban Development. The town of Walpole was recently approved for participation in this program. Insured property owners would be compensated according to the guidelines of the program for financial losses incurred from flooding. To qualify for this program, a community must submit an application and receive approval and enact flood plain zoning bylaws.

With this alternative, flooding of the major residential and commercial areas and the resulting damages to existing development and threat to human health and safety would remain. The dedicated open space area of 57 acres committed to the multiple-purpose structure would not be realized. The creation of a 17-acre pool to provide recreation and improve fish and wildlife habitat would not be achieved. The net annual monetary benefits that would be foregone by not implementing the project are about \$37,620.

All of the adverse environmental effects of the planned project would be avoided if this alternative were selected.

Reasons for Selecting the Planned Project

The project selected to meet the sponsors objectives includes: conservation land treatment; a multiple-purpose structure providing storage capacity for floodwater, fish and wildlife; and a section of channel work for flood prevention.

The land treatment phase will provide essential conservation land treatment to each acre of the watershed, and will reduce runoff, erosion and sediment; provide improved habitat for wildlife; and protect and enhance environmental quality.

Open space and a passive recreation area will be provided by the 17-acre pool of the multiple-purpose structure and 20 acres of adjacent land. The channel work in the urban area and storage of 207 acre-feet of floodwater will combine with the land treatment phase to reduce average annual floodwater damages by 99 percent.

Existing flood plain management will complement structural measures and the land treatment phase in alleviating future flood problems. Adequately enforced flood plain zoning will minimize future flood losses by controlling noncompatible uses in flood hazard areas. Flood insurance will reduce the economic impact of flooding by compensating participating property owners who incur losses.

The project as formulated was selected as the best means to achieve the project objectives while producing the least adverse affect on the environment.

WORKS OF IMPROVEMENT TO BE INSTALLEDLand Treatment

Land treatment measures will be installed throughout the watershed during the five year project installation period. Essential conservation treatment will be applied to all watershed lands. About 291 acres will receive treatment to achieve the desired level of protection or improvement. The remaining lands will receive treatment to supplement that which has already been applied. To accomplish this treatment, technical assistance will be provided through the Norfolk Conservation District to town boards, community leaders, and others for resource inventories, consultations, planning, and application of treatment measures. Measures will be installed for control of runoff and erosion, and protection and improvement of fish, wildlife, recreation and environmental values.

Essential conservation land treatment will be applied on about 40 acres of land expected to undergo development for residential, commercial, and related urban uses during the project installation period. To determine treatment needs, town boards will submit proposed development plans for the Conservation District to review and provide recommendations for treatment measures. Technical assistance will be provided to developers for installing the recommended measures. The measures to be recommended and installed could include: protection and maintenance of existing vegetation; temporary basins to trap sediment and other waterborne debris; structural measures to convey runoff water, in a non-erosive manner, to a suitable outlet; seeding, tree planting and mulchings; and establishment of forest buffer or other infiltration zones.

It is expected that improved land treatment or protection will also be applied to about 4 acres of cropland, 47 acres of land dedicated to wildlife and recreation uses, and 200 acres of woodland. To accomplish this treatment, technical assistance will be provided to landowners and operators for planning and applying treatment measures. Treatment could include wildlife habitat improvement and management; soil protection through proper water control and disposal and vegetative practices; and protection and management of woodland areas.

Assistance will also be provided to the watershed towns in preparing natural resource plans. These plans will provide resource inventory information and data to serve as a basis for planning and implementing land use changes and other measures to protect and enhance the towns' natural resources and environmental values. Natural resource plans will indicate the needs for measures and changes such as: preservation of minimum acreages of woodland, wildlife land, agricultural land, recreation land and open space; protection of wetland, historical and scenic natural areas; installation of water bodies for recreation, fish and/or wildlife; changes in land use; and detailed planning for future urban land use.

Consultive assistance and technical data will be provided to aid town boards in revising and developing land use and control ordinances.

Detailed soil surveys of the watershed have been completed. The survey is a scientific inventory of the soils which occur, and is used to indicate suitability, economic considerations, and conservation requirements of a land area for various uses. Soil surveys will provide basic information to guide land use and treatment decisions.

Structural Measures

The project includes a multiple-purpose structure at the Allen site for flood prevention and fish and wildlife, and a section of channel work for flood prevention. Both structures are located on Diamond Brook (see Project Map, Figure 5). Figures 1, 1a and 2 illustrate the major features of these structural measures. The multiple-purpose structure will provide a total storage capacity of 255 acre-feet, of which 207 acre-feet are for temporary floodwater detention, 43 acre-feet for fish and wildlife, and 5 acre-feet for sediment which is expected to accumulate during the project evaluation period (100 years). This structure will control runoff from 1.0 square mile or about 50 percent of the total drainage area of Diamond Brook.

The multiple-purpose structure will consist of an earth fill dam, a drop inlet principal spillway and an emergency spillway.

The dam will be of compacted earth fill about 22 feet in height and 1,350 feet in length. Fill material will consist of silts and till material in the core and coarser, more pervious glacial materials in the shell of the fill. The earth fill will be vegetated and landscaped as necessary to blend into its surroundings. The approximately 54,000 cubic yards of fill material required will be obtained from the emergency spillway and vicinity and upstream of the right abutment. The foundation of the dam is glacial deposition. The dam site is within an area where earthquakes occur that could be of sufficient magnitude to induce damages. Geologic conditions at the site that may lead to adverse effects during earthquakes include relatively thin swamp deposits, localized aquifers of glacio-fluvial sand, and gravel containing artesian water with hydrostatic heads above ground. The results of the foundation investigation indicate that corrective measures can be provided in the final design and construction of the dam.

In operation for the prevention of floods, the dam will automatically regulate runoff from a 100-year frequency storm by a principal spillway and the floodwater storage provided. The principal spillway consists of a reinforced concrete riser, outlet conduit, and impact structure. This outlet works will automatically release the temporarily stored floodwater at a rate which will minimize downstream flooding.

The impact structure is an energy dissipator to reduce the erosion potential of the released water before it enters the stream channel. A water control gate will be provided near the base of the riser to permit draining the reservoir for management of the fish and wildlife pool or during emergencies.

An emergency spillway will be excavated in earth on the left abutment of the dam. This spillway will be vegetated to pass storm flows in excess of the volume controlled by the floodwater storage and principal spillway release with minimum erosion. The emergency spillway is designed to operate, on the average, less often than once in 100 years.

The fish and wildlife pool provided by the Allen site multiple-purpose structure will have a surface area of 17 acres, maximum depth of about 7 feet and an average depth of about 3 feet. The pool will be managed as a warm water fish habitat and with its periphery as a nesting and resting area for waterfowl. About 20 acres of town-owned land adjacent to the fish and wildlife pool will be managed for wildlife. This 20 acre area consists of about 7 acres of shrub swamp with the remaining area being mostly wooded.

In consideration of the intended use of the fish and wildlife pool and adjacent public land area, the town of Walpole decided that construction of sanitary facilities is not needed. The pool and land area will be developed and managed for fish and wildlife habitat and used primarily for fishing, nature study, wildlife observation, and other forms of passive recreation. If a need becomes apparent, based on a monitoring program by the Walpole Board of Health, sanitary facilities that meet state and local requirements will be provided by the town.

Clearing during construction will be limited to the dam, emergency spillway, fish and wildlife pool, and borrow and other areas necessary to facilitate construction, and will total about 27 acres. Except for the fish and wildlife pool, these areas will be revegetated with suitable grasses, legumes, trees, or shrubs. Topsoil that is stockpiled during construction of the dam will be used as needed to help ensure adequate establishment of vegetation.

The existing vegetative cover will be retained on the 33 acre area of the floodpool that will be subject to occasional inundation, except for about 3 acres which will be removed to obtain borrow in constructing the dam.

There are no known existing improvements that will require alteration, modification, or change in location as a result of installing the multiple-purpose structure. Installation of the structure will not require relocations of persons, businesses or farm operations.

About 1,180 feet of channel work will be installed to supplement the multiple-purpose structure in providing flood protection for the business district of Walpole. In the channel work area, Diamond Brook is a perennial, previously modified stream. Glacial deposits along a major portion of the proposed floodwater conduit and outlet channel have been altered by excavations and fillings during urban development.

The channel work consists primarily of installation of approximately 780 feet of reinforced concrete conduit to supplement the existing conduit, and enlargement of approximately 400 feet of existing stream channel to provide an adequate outlet for both conduits. Other works related to the channel work are minor improvements of the entrance of the existing conduit and improvement of the entrance channel to the existing and proposed conduits. The proposed conduit will have reinforced concrete headwall structures and short sections of riprap to provide stable conditions at the inlet and outlet ends.

The new conduit will be located generally adjacent and parallel to the existing conduit within the business district of Walpole. It will cross the intersection of Main Street, (State Route 1A) and East Street, (State Route 27) and extend through a parking lot and under the Penn Central Railroad tracks to the stream channel downstream of the railroad. Through the street intersection, the conduit will cross water, sewage, drainage, telephone and electric utility lines. The conduit may be jacked through the railroad embankment, if necessary, to avoid interruption of railroad service.

The existing conduit has a capacity of about 160 cubic feet per second. The planned conduit designed to carry flood flows will have a capacity of about 510 cubic feet per second. The combined capacity will be about 670 cubic feet per second.

Excavation for the floodwater conduit will be in manmade fill and glacial deposits. Suitable excavated materials will be used as backfill; unsuitable and excess materials will be removed and placed in a disposal area to be designated by appropriate town authorities. Care will be taken to avoid adverse environmental effects.

Enlargement of the existing stream channel will extend from near the downstream end of the planned conduit to the confluence with the Neponset River. The proposed channel will have a bottom width of 20 feet, depth of about 5 feet and side slopes of 1.5 to 1. Excavation of about 1,700 cubic yards of earth will be required. Alternating the channel work from one side to the other will be done to minimize damage to the higher quality wildlife habitat. Channel excavation and spoil spreading on the upstream 200 feet will be conducted from and

on the left (west) bank. On the remaining 200 feet, this work will be conducted on the right bank. To avoid pocketing of water and creating potential disease vector hazards, all spoil will be spread so as to provide adequate surface drainage.

An existing disposal area for broken concrete pavement, occupying about one-fourth acre on the west bank, will be covered with spoil. This and the other disturbed areas, excepting the channel bottom will be vegetated with reed canarygrass and silky dogwood for soil protection and to restore food, cover and nesting sites for wildlife.

There is no indication that bedrock will be encountered with the depths of excavation required for installing the floodwater conduit and outlet channel, or that foundation or stability problems will be encountered.

Backwater from the Neponset River, particularly during flood periods, will adversely affect the proposed floodwater conduit and existing conduit by reducing the elevation drop (energy head) available. The purpose of enlarging the stream channel section between the conduit outlets and the Neponset River is to minimize this backwater effect at the conduits.

The design capacity of the floodwater conduit and outlet channel is based on the capacity needed to safely pass the peak flood flow of a storm equal to the August 1955 event, as modified by expected future watershed conditions and the multiple-purpose structure.

Partial clearing of about one acre of idle land will be necessary to install the channel. Dense herbaceous plants, and scattered shrubs and trees comprise the vegetative cover on this area. Care will be taken to preserve desirable tree specimens of existing species.

No relocations of persons, business or farm operations will result from installation of the channel work. Alterations, modifications, and possible changes in locations of existing public utilities will be required by installation of the proposed conduit in the area of the intersection of Main and East Streets. The responsible public works department or public utility company will supervise or perform the work to ensure minimum disruption of service.

The final designs of the structural measures and construction procedures will give maximum consideration to minimizing adverse effects to the environment. Erosion and pollution control will be a major concern. Areas to be cleared will be planned for the minimum amount necessary for construction and maintenance. Plant materials used for vegetating disturbed areas will be selected for their ability to control erosion, provide wildlife food and cover, and for beauty and ease of maintenance. Project induced vector problems will be minimized to the extent possible.

Requirements for erosion and pollution control during construction will be outlined in construction contracts. If special problems of pollution arise during construction or measures not in the contract are needed, a contract modification will be prepared or other appropriate action taken. To minimize erosion and water and air pollution the following measures or techniques will be considered in preparing construction plans and specifications:

1. The area and duration of exposure of erodible soils will be reduced to the greatest extent practicable.
2. Soils will be protected by using temporary vegetation or mulch or by accelerated establishment of permanent vegetation. Segments of work will be completed and protected as rapidly as is practicable.
3. The rate of runoff from the construction site will be mechanically retarded and the disposal of runoff will be controlled.
4. Sediment resulting from construction will be trapped in temporary or permanent debris basins.
5. Dust will be kept within tolerable limits on haul roads and at construction sites by application of methods acceptable under Regulation No. 9 of the State Air Pollution Implementation Plan.
6. Temporary bridges or culverts will be used where fording of streams is objectionable.
7. Temporary measures will be used to keep erosion under control if construction is suspended for any appreciable length of time.
8. Protection against pollutants such as chemicals, fuels, lubricants, sewage, etc., will be provided.
9. Construction will be timed to avoid rainy seasons if practical.
10. Sanitary facilities will not be located over or adjacent to streams, wells, or springs.
11. Grass or brush fires will be prevented.

Contractors must comply with the manual, Safety and Health Regulations for Construction, published by the U.S. Department of the Interior, Bureau of Reclamation, and must also comply with state and local health, sanitation and pollution regulations.

During construction, care will be taken to avoid creating breeding areas for mosquitoes and other aquatic insects that are vectors of human disease organisms. Work will include grading of borrow areas to be self draining, placing and grading of spoil material so as

not to pocket water, and care during other construction operations that could cause shallow water breeding areas. Other consideration will be given to minimizing project induced vector problems to the maximum degree permitted by the primary functions of the structures, and other environmental concerns as agreed to by the sponsors and responsible health agencies.

Trees or other cleared materials will be salvaged for merchantable wood products as practicable. Waste products will be burned or buried, depending on the nature of the material, applicable regulations and the desires of town authorities.

The National Register of Historic Places lists no properties within the watershed. During consultations with the Massachusetts Historical Commission and the State Archaeologist they advised that no properties of historical or archaeological value listed in their present inventory would be affected by installation of the structural measures. In addition, a survey has been conducted by a qualified archaeologist. This survey indicates that no archaeological resources will be affected by project measures (a summary report is included as Appendix D). However, the archaeologist points out that the existence of such resources cannot be totally ruled out. As recommended by the archaeologist, construction personnel will be made aware of the possibility of archaeological resources, especially when removing fill from borrow areas. If any discoveries are made during construction, the National Park Service and appropriate state interests will be notified in compliance with the Federal Reservoir Salvage Act of 1960, (PL86-523). Construction would not be continued until necessary actions satisfactory to the sponsors and appropriate authorities have been implemented. Since this is a federally assisted local project, there will be no change in existing responsibilities of any federal agency under Executive Order 11593 with respect to archaeological and historical resources.

Nonstructural Measures

Needed flood plain management measures have been or are being instituted in the watershed. These measures are not dependent on the project and are therefore considered to be "without project" conditions. The town of Walpole has enacted a flood plain zoning bylaw and is participating in the National Flood Insurance Program. The town has been approved for participation under the emergency flood insurance program. Steps are now being taken to enable participation under the regular program.

Assistance will be provided to the town through ongoing programs for effective application of regulatory measures. Technical assistance will be provided for such items as: delineation of flood prone areas; establishment of flood level reference elevations at specific locations; establishment of encroachment lines; and review of development plans for possible effects on flood plain storage and flow capacity.

There are three instruments, in addition to flood plain zoning, by which towns in Massachusetts are able to regulate the use of wetland and flood plain areas. These methods of regulation, in addition to public acquisition, will be used when appropriate to protect the natural ecological and hydrological values of wetlands. Each of these methods is authorized (granted) by state legislation under one or more of the General Laws of the Commonwealth. A brief description of each of these Acts follows:

1. Wetlands Protection Act (General Laws, Chapter 131, Section 40, as amended in 1974 by Chapter 818). This law requires that any person, firm or corporation, public or private, intending to remove, fill, dredge, or alter a wetland must insure, by following various procedural and technical steps, that the activity will have no significant adverse effect on ground water supply, to flood control, to storm damage prevention, to prevention of pollution, to protection of land containing shellfish, or to the protection of fisheries. In effect, the owner must develop his wetlands in accord with the public's interest and safety. (Wetland is interpreted as just about any land which is periodically wet).
2. Inland Wetlands Restriction Act (General Laws, Chapter 131, Section 40A, as amended in 1972 by Chapter 782). This law is designed to supplement the regulative approach of the Wetlands Protection Act. This law establishes a planning approach to wetland protection, and initiation is not dependent upon any proposed adverse action on a wetland or flood plain. Through this law, the Commissioner of the Department of Natural Resources in order to preserve and promote public safety, private property, wildlife, fisheries, water resources, flood plain areas and agriculture, is empowered and directed to issue orders restricting development of inland wetlands.
3. Conservation Restriction Act (General Laws, Chapter 666 of the Acts of 1969). This law serves as a useful device to assist conservation commissions in the preservation of open spaces. A conservation restriction is a right (received as a gift or purchased) which is written into a will or deed appropriate to retaining land or water areas predominantly in their natural, scenic or open conditions or in agricultural or forest use and to forbid or limit some activity or activities such as: construction, dumping, excavation, dredging, destruction of trees, activities detrimental to such retention of land or water areas.

Flood plain areas that should be protected for their ecological and other environmental values will be identified in the natural resource inventories and plans carried out under the land treatment phase of the project.

Land Use Changes

Present land uses on about 58 acres of watershed land will be changed by installation of the planned structural measures. In addition, it is expected that land use changes will result from implementation of flood plain management. Residential, commercial and related development during the project installation period are expected to occur on about 40 acres of land.

The present land uses of the area required for each major feature of the structural measures are as follows in Table F:

TABLE F - PRESENT LAND USE OF AREA REQUIRED* FOR STRUCTURES

Structural Measures & Major Feature	Total Land Area Req'd (Acres)	Present Land Use (Acres)		
		Forest Land	Idle (Grass and Shrub)	Water Surface
<u>Multiple-Purpose Structure</u>				
Dam & Spillway	7	6	1	
Fish & Wildlife Pool	17	17 ^{1/}		
Flood Pool	33	16 ^{2/}	13 ^{3/}	4
<u>Channel Work</u>				
Floodwater Conduit*				
Outlet Channel	1		1	
TOTALS	58	39	15	4

The 57 acres of land that will be committed to the multiple-purpose structure is now mostly wooded. This woodland, with the smaller areas of other cover that are present, constitutes a generally good wildlife habitat. The woodland consists of a moderate to low quality timber stand..

* Present urban use (streets, parking lots, etc.), will not be changed.

^{1/} Includes 12 acres of wooded swamp (Type 7) wetland.

^{2/} Includes 4 acres of wooded swamp (Type 7) wetland.

^{3/} Includes 8 acres of shrub swamp (Type 6) wetland.

The present use and quality of the multiple-purpose structure site for wildlife habitat is related to the vegetative cover which exists. Also, how this vegetative cover will be affected will vary with the major features of the structure. Therefore, the following descriptions of vegetative cover types are provided for the land area required by each major feature.

The dam and emergency spillway will require 7 acres of land which will be cleared of all existing vegetation and vegetated with suitable grasses and legumes when construction is completed. This 7 acres presently consists of the following three cover types:

1. Hardwood-Softwood Woodland - There are 3 acres of a high density stand of mixed hardwood-softwood woodland in a size range of sapling to small sawlog (2-14 inch diameter). White, red, and scarlet oak, American beech, and white pine are the dominant tree species. Understory vegetation is generally thick and consists of witch hazel, greenbrier, arrowwood, spicebush, sassafras, and sprouts of American chestnut.
2. Hardwood Woodland - There are 3 acres of predominantly hardwood woodland in a pole to small sawlog size range (5-14 inch diameter). Tree stand density ranges from low to high. The dominant tree species are white, red, and scarlet oaks. American beech, and red maple. Understory vegetation is sparse, consisting largely of flowering dogwood, sassafras, greenbrier, and American chestnut sprouts.
3. Abandoned Agricultural Land - There is a 1 acre abandoned field which is undergoing rapid plant succession. Invading woody plants are pin cherry, staghorn sumac, red cedar, and red maple. Invading shrubs are tatarian honeysuckle and arrowwood. Herbaceous vegetation is timothy grass, fescue grass, little bluestem grass, wild strawberry, goldenrod, and various species of aster (Compositae).

The fish and wildlife pool area consists of 17 acres of land which will be cleared and permanently inundated. It is composed of the following two cover types:

1. Hardwood Woodland - There are 13 acres of predominantly hardwood woodland in the pole to small sawlog size range (5-14 inch diameter) which ranges from a low to high stand density. White, red, and scarlet oak, American beech, and red maple are the dominant species. Understory plants are witch hazel, greenbrier, spicebush, sarsaparilla, and flowering dogwood. About 8 acres of this area meet the classification of a wooded swamp, Type 7 wetland 1/.

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

2. Hardwood-Softwood Woodland - There are 4 acres of mixed hardwood-softwood woodland with hardwood predominating. The size range varies from sapling to small sawlog (2-14 inch diameter) and is of high stand density. White, red, and scarlet oak, American beech, red maple, and white pine are the dominant tree species. Understory vegetation consists of scattered plants to very thick growth of witch hazel, greenbrier, arrowwood, spicebush, and sassafras. This area meets the definition of a wooded swamp, Type 7, wetland 1/.

The flood pool area consists of 33 acres of land which will be occasionally inundated by storage of floodwater. Except for 3 acres, the present vegetation of this area will remain. The 3 acres will be cleared of vegetation for removal of soil material for building the dam and will be revegetated upon completion of construction. This area presently supports a hardwood woodland of white, red, and scarlet oaks, and American beech. The remaining 30 acres of the flood pool is composed of the following five cover types:

1. Abandoned Agricultural Land - There are 3 small fields which total 5 acres in area. Woody vegetation is pin cherry, staghorn sumac, tatarian honeysuckle, red cedar (erect form), arrowwood, and red maple seedlings. Herbaceous vegetation at ground level is timothy grass, fescue grass, and wild strawberry.
2. Shrub Swamp- There are 8 acres classified as a Type 6 wetland 1/. Highbush blueberry, silky dogwood, speckled alder, arrowwood, and spicebush are the dominant shrub vegetation. Seedling and sapling size red maple line the perimeter of this wetland area.
3. Fresh Open Water - A 4 acre manmade pond is located in the upstream end of the flood pool. This pond is greater than three feet deep and is classified as a Type 5 wetland 1/. The pond supports duckweed and one or more species of pondweed (Potomageton).
4. Hardwood Woodland - The 6 acres of predominantly hardwood woodland range in size from sapling to small sawlog (2-14 inch diameter) and is of low to high density. About 4 acres of this area meet the classification of a wooded swamp, Type 7 wetland 1/. Dominant trees are white, red, and scarlet oaks, American beech and red maple. Understory vegetation is sparse and consists of scattered plants of flowering dogwood, sassafras, greenbrier, and sprouts of American chestnut.
5. Hardwood-Softwood Woodland - There are 7 acres of mixed hardwood-softwood with hardwoods predominating. The size range varies from pole to small sawlog (5-14 inches diameter) and the woodland is of high density. Dominant trees are white, red and scarlet oak, American beech, red maple, and white pine. Understory vegetation ranges from scattered plants to very thick in places and consists of witch hazel, arrowwood, spicebush, greenbrier, and sassafras.

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office Washington, D.C., 1936

The present use and quality of the multiple-purpose structure site as a wildlife habitat is as follows for the cover types that exist:

1. Wetlands - The 8 acres of shrub swamp, Type 6 wetland 1/, and 4 acres of fresh open water, Type 5 wetland 1/ in the flood pool area provide feeding and resting habitat for migrating waterfowl, and are used particularly during spring and fall migrations. Mallard, black, and wood ducks are the primary waterfowl species which use these wetlands in inland portions of Massachusetts. These wetlands provide good feeding habitat for green heron and the open water area provides a fair feeding habitat for the belted kingfisher.

Excellent habitat is provided for the muskrat and other water oriented mammals, particularly around the open water area of Allen Pond.

In Massachusetts, wooded swamps (Type 7 1/ wetland) are only important as nesting and feeding areas to wood and black ducks when the wetland borders permanent open water. The U.S. Fish and Wildlife Service 2/ has classified more than one half of Massachusetts wooded swamps (25,865 of 47,710 acres) as having negligible waterfowl value. Only 5,075 acres are classified as providing high to moderately high waterfowl value. Within the area encompassed by the planned permanent pool there are presently no bodies of open water adjacent to the 12 acres of wooded swamp, consequently the waterfowl value is negligible.

In the flood pool, there is a wooded swamp wetland adjacent to an 8 acre shrub swamp. Since the shrub swamp has a one-half acre area of open water, the overall value of the shrub swamp and wooded swamp would be moderately high for waterfowl, especially black and wood duck.

Mammals which find suitable habitat in the wooded swamp wetlands within the planned fish and wildlife pool and flood pool area include short-tail weasel and raccoon.

Water associated songbirds such as yellow warbler, red winged black-bird, swamp sparrow, tree swallow, and northern yellowthroat warbler are present around the wetland areas. Good nesting and feeding habitat is present for these and other songbird species as well as the wood-cock, a migratory game bird.

Excellent habitat for amphibians such as common newt, leopard frog, wood frog, green frog, and spring peeper is available in and around the wetland acreage.

The wetlands also provide excellent habitat for certain reptile species. Reptiles found in the area include northern water garter snake, ribbon snake, painted turtle, wood turtle, and snapping turtle.

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

2/ Wetlands of Massachusetts, United States Department of the Interior, Fish and Wildlife Service, Bureau of River Basin Studies, revised, October 1959.

2. Hardwood Woodland - This cover type provides good habitat for gray squirrel and eastern chipmunk. Habitat for gray squirrel will improve as oaks reach maturity and provide an increased acorn crop and more numerous cavities for nesting. Habitat for woodland songbirds such as chickadees, nuthatches, blue jays, hairy woodpeckers, and downy woodpeckers is good and will improve with maturity of the forest trees. Eastern cottontail rabbit habitat is poor in this cover type since understory shrubs are scattered and sparse.
3. Hardwood-Softwood Woodland - The mixed hardwood-softwood woodland provides fair to good habitat for gray squirrel and eastern chipmunks depending primarily on the size of the oaks and beech. Areas with the larger oak and beech trees are providing a better source of food and suitable nesting cavities. Habitat for woodland songbirds is good. Eastern cottontail rabbit habitat is poor to fair depending primarily on the density of understory shrubs which provide the bulk of the food and escape cover.
4. Abandoned Agricultural Land - The abandoned agricultural land is providing good habitat for the meadow voles, white-footed mice and short-tailed shrew all of which are present in or around the perimeter of the abandoned fields. Good habitat is also provided for songbirds associated with reverting open land and shrub thickets, such as the yellow-shafted flicker, rufous-sided towhee, goldfinch, catbird, and cardinal. These species find good nesting and feeding habitat in and around the perimeter of the abandoned fields. Habitat for the eastern cottontail rabbit is good in and around these overgrown fields. Food and nesting and escape cover is readily available to cottontail rabbits which are common in and near this vegetative cover type.

Whitetail deer do not use or traverse the area planned for the structure and pool. Adjacent urban areas make this particular area too small to constitute a viable deer habitat area. A resident who has lived near the site for 25 years reports that deer have not been seen in this area since Interstate Route 95 (I-95) was constructed. This highway has apparently disrupted deer movements from the large wooded area in the Moose Hill area south of the highway. No evidence of deer use was observed in the area during field investigations.

Many species of songbirds are either infrequently found in the site area or are abundant only during spring and fall migration periods. Other species are abundant in winter when they use the general area as a wintering ground.

The outlet channel will require 1 acre of idle land which will be cleared as necessary to permit excavation and the spreading of spoil material. This area is a Type 2 wetland 1/ (Inland Fresh Meadow) consisting predominately of herbaceous plants which are by order of dominance: purple loosestrife, goldenrod, knotweed, cinnamon fern and various sedge species (Carex) pokeberry, and nightshade. Scattered through the area are clumps of the following shrubs by order of dominance: silky dogwood, arrowwood, speckled alder, elderberry and wild spirea. Also scattered through the area are the following tree species and their size range (diameter, measured 4.5 feet above the ground): boxelder (12 inch - 1 only), white ash (10 inch - 16 inch), red maple (to 4 inch), American elm (3 inch - 8 inch), black willow (16 inch - 1 only) and black cherry (7 inch - 1 only).

Because of the close proximity of the planned outlet channel to urban development, the wildlife habitat value of this area is primarily for songbirds, cottontail rabbits, and muskrats. A local resident reports that ringneck pheasants are occasionally seen in this vicinity. Only nonconsumptive uses of the wildlife resource are acceptable in this area.

No stream sport fishing exists on Diamond Brook within the multiple-purpose structure site or in the channel work area. A warm water fishery is present in Allen Pond, which is within the flood pool area of the multiple-purpose structure. Warm water fish species present in the pond include brown bullhead, bluegill sunfish, and largemouth bass.

Other uses will be made of the land areas required by the structural measures that are compatible with their planned functions. The dam and spillway and the outlet channel area will provide open space and wildlife habitat. The flood pool area will also provide wildlife habitat and open space, and can serve for other conservation and recreation uses that are compatible with occasional inundation by storage of floodwater.

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Measures

The estimated total cost for installation of land treatment measures is \$81,300 of which \$75,700 is for application of the measures and \$5,600 is for technical assistance. Costs are based on current and proposed expenditures for supervision, labor, equipment and materials needed to perform the assistance or complete the particular measures. Technical assistance through going conservation programs will be continued at the rate that existed prior to completion of this plan and will amount to about \$1,300 over the project installation period. The Soil Conservation Service will use \$2,200 and the Forest Service will use \$2,100 of PL-566 funds for technical assistance to accelerate the rate of application of land treatment measures and to assist in natural resource planning. Estimated costs for installing land treatment measures are summarized in Table 1.

Structural Measures

Estimated costs to install structural measures are shown in Tables 1 and 2. These installation costs include construction, engineering services, land rights and project administration.

Construction Costs

Cost estimates, prepared for each structural measure, were based on preliminary designs. Prior to construction, the most economical design for each structural measure will be prepared which most nearly meets the project objectives. The construction cost for each structural measure is based on the engineer's estimate of quantities required and 1975 unit construction costs applicable to the area.

Engineering Services Costs

The cost of engineering services for the structural measures includes all costs associated with surveys for design, geologic investigations, final design and preparation of plans and specifications. The estimates for engineering services costs were based on the cost of installing comparable structures in other watershed projects in the Northeast.

Land Rights Costs

Land rights costs consist of the estimated value of land and water rights to be acquired for project purposes; legal, survey and other costs associated with acquisition; and costs of relocating or modifying existing facilities.

Costs for the land to be acquired were based on fair market value appraisals, and a recent sale transaction for similar land with appropriate adjustments to account for the rising trend in land values. Costs for relocation or modification of utilities and reconstruction of streets and parking lots for installation of the channel work were based on current unit costs for this type of work and include an allowance for associated engineering services. Land rights for the channel work also include a cost to offset loss of business and inconvenience to commercial establishments in the immediate vicinity, and to provide for safety measures during placement of the conduit through the railroad fill.

Project Administration Costs

Project administration costs are the administrative costs associated with the installation of structural measures. These costs include administration of contracts, construction surveys, necessary inspection services during construction to insure compliance with the plans and specifications, and other associated costs. These costs were estimated for this project based on expenditures for these services in similar type projects.

The Service and the sponsors will each furnish the administrative services they require and will bear the costs which they incur. These costs are estimated at \$115,200 and \$9,800 respectively.

Cost Allocation and Cost Sharing

The cost of installing land treatment measures, estimated at \$75,700 will be borne by landowners or developers.

Cost for technical assistance related to the installation of land treatment measures, estimated at \$5,600 will be shared by the Soil Conservation Service, the Massachusetts Department of Natural Resources, and the U.S. Forest Service.

Joint construction and engineering costs for the multiple-purpose structure were allocated to the purposes served by the Use-of-Facilities Method. On this basis, 83.1% of the cost is for flood prevention and 16.9% for fish and wildlife. Land rights costs of \$41,300 are specific costs for fish and wildlife and will be borne entirely by other funds. Pl-566 funds will bear all of the engineering costs and 91.5% of the construction costs. Other funds will bear the land rights costs and 8.5% of the construction cost.

All costs for the channel work were allocated to flood prevention. PL-566 funds will bear the entire costs for engineering and construction. Other funds will bear all the cost for land rights.

Project administration costs for the project are estimated to be \$125,000. The sponsors will be solely responsible for contract administration. The Service and the sponsors will each furnish the administrative services which they require, and each will pay the costs which they incur for those services.

Table 2A shows a summary of the cost allocation and cost sharing for the structural works of improvement.

Fund Obligations

The estimated obligation of total project funds for land treatment and structural measures for each fiscal year during the installation period is as follows:

Year	PL-566 Funds (Dollars)	Other Funds (Dollars)	Total (Dollars)
First			
Structural Measures	37,000	40,200	77,200
Land Treatment	<u>460</u>	<u>13,860</u>	<u>14,320</u>
Yearly Total	37,460	54,060	91,520
Second			
Structural Measures	352,400	33,900	386,300
Land Treatment	<u>560</u>	<u>15,460</u>	<u>16,020</u>
Yearly Total	352,960	49,360	402,320
Third			
Structural Measures	409,700	60,400	470,100
Land Treatment	<u>660</u>	<u>15,860</u>	<u>16,520</u>
Yearly Total	410,360	76,260	486,620
Fourth			
Structural Measures	---	---	---
Land Treatment	<u>1,360</u>	<u>16,160</u>	<u>17,520</u>
Yearly Total	1,360	16,160	17,520
Fifth			
Structural Measures			
Land Treatment	<u>1,260</u>	<u>15,660</u>	<u>16,920</u>
Yearly Total	1,260	15,660	16,920
Project Period Totals			
Structural Measures	799,100	134,500	933,600
Land Treatment	<u>4,300</u>	<u>77,000</u>	<u>81,300</u>
GRAND TOTAL	803,400	211,500	1,014,900

EFFECTS OF WORKS OF IMPROVEMENT

Conservation Land Treatment

Conservation land treatment will reduce soil erosion and sedimentation from areas disturbed during urban development. Resource inventories will provide information needed by local government, developers, and others in making sound land use decisions. Assistance in preparing natural resource plans will provide information and data to serve as a basis for planning and implementing land use changes and other measures necessary for protecting and enhancing natural resources and their environmental values.

Use of natural resource plans by planning boards, conservation commissions and developers will result in better land use patterns and more orderly town development. Installed measures and multiple use management of natural resources will provide recreation, fish and wildlife habitat, and will protect environmental values.

Structural Measures

The total reduction in average annual flood damages along Diamond Brook with the installation of the project is estimated to be 99 percent of which 97 percent will result from the structural measures. In the six damage reaches (see Figure 5, Project Map), this reduction ranged from 82 percent to nearly 100 percent. In addition to roads and bridges, about 15 residences, 45 commercial establishments and a school will be protected.

The works of improvement included in this plan will provide protection from a storm equal to the August 1955 event, in the major damage areas of downtown Walpole (Reaches 1, 2 and 3, from the railroad bridge upstream to Diamond Street), and to the area from Clark Pond upstream to the multiple-purpose structure (Reach 6, Washington Street area). A lesser degree of protection will be provided to the area from Diamond Street to Clark Pond (Reaches 4 and 5). In this area, roads and bridges and a residence will be subject to damage from a 25 to 50 year frequency event, with project. This is a reduction from the present frequency of flooding of about once in 3 years. Nuisance-type flooding will occur from a 100-year frequency flood in the low areas near the mouth of Diamond Brook due to backwater from the Neponset River and in the Memorial Pond area. With the project, a recurrence of the 1968 storm would cause no damage to existing development along Diamond Brook. The frequency of a storm causing flood damages in the major areas of downtown Walpole will be reduced from about a 5-year frequency to about a 500-year frequency event. See Figure 3 for a delineation of areas affected by a 100-year frequency flood, "with" and "without" the project.

The peak flow that would occur during an event equivalent to the August 1955 storm would be reduced about 45 percent or from 1,270 cubic feet per second to 670 cubic feet per second at the mouth of Diamond Brook.

Installation of structural measures will cause temporary increases in noise, air pollution by dust and exhaust emission, and turbidity and sediment in Diamond Brook and the Neponset River.

Installation of the floodwater conduit portion of the channel work will cause temporary interruptions to traffic flow and services provided by water, sewage, drainage, telephone, and electric utilities.

About 58 acres of land will be required to install the planned structural measures. For the areas affected, a description of the vegetative cover types and their quality and use as wildlife habitat is provided in the "Works of Improvement to be Installed" section of this plan under "Land Use Changes."

Ten acres of forest resources and associated woodland wildlife habitat will be lost to provide space for the dam and emergency spillway of the multiple-purpose structure and to obtain borrow material for the earth fill dam. The fish and wildlife pool will necessitate the loss of 17 acres of forest resources and associated wildlife habitat. This 17 acres of habitat consists of 12 acres of wetland habitat (wooded swamp) and 5 acres of woodland habitat. The total of 27 acres of forest resources to be lost due to installation of the dam and pool represents about 1 percent of the forest area in the watershed.

Sixteen acres of wetland wildlife habitat and 14 acres of woodland wildlife habitat which occur in the flood pool will be occasionally inundated by the temporary storage of floodwater. The wildlife habitat value will be impaired or temporarily lost depending upon the frequency, duration, season and depth of inundation.

Habitat in 850 feet of perennial stream and 400 feet of intermittent stream will be lost due to construction of the dam and permanent inundation by the 17-acre fish and wildlife pool. Inundation of 250 feet of intermittent stream will occur occasionally from the storage of floodwater. The stream habitat will be impaired or temporarily lost depending upon the frequency, duration, season and depth of inundation.

The 17-acre fish and wildlife pool may raise downstream water temperature 20 to 40 F. This amount would not be sufficient to change the state water quality classification of Diamond Brook (see Table C). Bottom water release, to prevent water temperature increases, is not practical since the planned permanent pool is shallow (7 feet maximum) and thermal stratification of the pool will not occur. Flow from the drains in the foundation of the dam could cause a temperature decrease depending upon the amount of flow, especially during late summer. This drain flow could negate any water temperature increase incurred in the impoundment.

The recreational use of the permanent pool and adjacent conservation area is not expected to be heavy. However, the public use of this 37-acre area may result in some impairment of its value as wildlife habitat.

Erosion that will occur during dam construction could range from about 10 tons to 300 tons depending on rainfall intensity and duration during the construction period. Preventive measures will be taken to control erosion and sedimentation during construction. However, it is expected that some eroded material will enter Diamond Brook and be deposited in Clark Pond, and may reduce water storage volume and temporarily impair its aquatic habitat.

The 10 acres of land committed to the dam, spillway, and borrow area will be revegetated with grasses and legumes. The established vegetation will provide habitat for openland wildlife and a feeding area for various species of woodland wildlife.

The vegetated dam and spillway will create 2,800 feet of wildlife "edge" consisting of the interface between openland and woodland vegetation.

The 17-acre fish and wildlife pool will provide habitat for warm water fish and wetland wildlife, and will also provide warm water fishing recreation. This pool will have potential for a peak use $\frac{1}{4}$ of about 70 fisherman at any point in time. Approximately 20 acres of public land adjacent to the pool will provide opportunity for nature study, wildlife observation and other passive recreation. Hunting will not be permitted on this 37-acre area as it was judged to be incompatible with the planned nonconsumptive wildlife uses.

Dedication and use of the 57-acre land area for flood control, recreation, and conservation purposes assures that it will not be subject to urban development. This land area will also serve as an eventual oasis of open space land where the visitor can find solitude and a temporary retreat from the urban pressures which he daily encounters. The present open space values of this acreage are probably very small as compared to what their future values will be as urbanization consumes an increasing percentage of the watershed area.

Channel work will reduce the quality of the aquatic habitat in the 400-foot reach where the existing channel will be enlarged, and will destroy 1 acre of wetland (Type 2, Inland Fresh Meadow) ^{2/} wildlife habitat. Reed canarygrass and silky dogwood will be planted on the graded spoil and banks to replace some of the wetland wildlife habitat values lost by construction. Covering and revegetating the one-quarter acre disposal area for broken concrete pavement that exists within the graded spoil area will provide food and cover for wildlife on an area where it was previously lost.

^{1/} Outdoor Recreation Space Standards, United States Department of the Interior, Bureau of Outdoor Recreation, U.S. Government Printing Office, Washington, D.C., March 1970.

^{2/} Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D. C., 1956.

The loss of 13 acres of wetland amounts to a 19 percent reduction in total wetland acreage in the watershed due to the planned project. However, the 17-acre permanent pool will undergo natural plant succession and will eventually constitute a manmade inland open fresh water (Type 5 1/) wetland. Once this plant succession has occurred the wetland acreage within the watershed will have increased by 4 acres or 2 percent over the present amount.

The National Register of Historic Places lists no properties within the watershed. During consultations with the Massachusetts Historical Commission and the State Archaeologist, they advised that no properties of historical or archaeological value listed in their present inventory would be affected by installation of the structural measures. In addition, a survey has been conducted by a qualified archaeologist. This survey shows that no archaeological resources will be affected by project measures (a summary report is included as an appendix to the environmental impact statement for this project). If any discoveries are made during construction the National Park Service and appropriate state interests will be notified in compliance with the Federal Reservoir Salvage Act of 1960, (PL86-523). Construction would not be continued until necessary actions satisfactory to the sponsors and appropriate authorities have been implemented.

Economic and Social

The effect of the proposed project on the economy of the area, other than the flood prevention benefits, would be minimal. Project measures will not facilitate increased production of goods or services other than passive recreational uses. Residential or commercial development is not planned or expected to occur as a result of the project, nor will land values be measurably altered. The loss of production or use of lands within the dam and pool area would have little economic significance.

Of the approximately one half million dollars to be expended for construction of the structural measures, probably less than 5 percent of this amount will be for local labor and materials. Some additional local expenditures will likely be made by construction workers for meals, rooms, and entertainment.

Business disruptions during installation of the floodwater conduit will have a negligible effect on a townwide basis. There may be a temporary loss of business in the immediate vicinity during construction.

The economic effects from operation and maintenance of project measures will be minor. Less than 1 man-year of employment annually will be

1/ Wetlands of the United States, Circular 39, United States Department of the Interior, Fish and Wildlife Service, U.S. Government Printing Office, Washington, D.C., 1956.

required. Materials needed for operation and maintenance, such as lime, fertilizer, seed, and machinery will not require a significant expenditure.

In addition to monetary benefits from the project measures, the project will tend to improve public health, increase employment security, lessen hazards to life and property, provide a sense of stability to the communities and contribute to maintaining and improving the quality of the environment.

PROJECT BENEFITS

The combined program of land treatment and structural measures will reduce the average annual floodwater damages by \$82,340 of which \$80,730 will result from the system of structural measures.

Indirect benefits attributable to the project measures were estimated to be \$16,070. These benefits result from reducing the flood related effects of interrupted services, loss of wages, increased expense of rerouting traffic, loss of income by businesses and other such losses.

Secondary benefits from a national viewpoint were not considered pertinent to economic evaluations and, therefore, were not evaluated. The local secondary benefits were considered to be equal to ten percent of the direct primary benefits, or \$6,630.

Because of the intended use of the water resource improvement for fish and wildlife resource preservation, benefits were assumed equal to the cost.

COMPARISON OF BENEFITS AND COSTS

The projects' benefit-cost ratio for structural works of improvement is 1.7 to 1.0, with annual benefits of \$87,360 and annual costs of \$51,350. Without the inclusion of secondary benefits, the benefit-cost ratio is 1.6 to 1. The annual benefits, annual costs and benefit-cost ratio are shown in Table 6.

PROJECT INSTALLATION

This plan will be carried out as a joint undertaking of non-federal interests and the federal government. Non-federal interests include: individual landowners; the Norfolk Conservation District; the towns of Walpole and Sharon; the Massachusetts Department of Natural Resources, Division of Conservation Services, Division of Fisheries and Game and Division of Forests and Parks; and the Massachusetts Water Resources Commission. Participating federal agencies include: the Soil Conservation Service, the Forest Service, and the Cooperative Extension Service of the U.S. Department of Agriculture.

Technical assistance for the review of urban development plans and for preparing natural resource inventories and plans will be provided by members of the Natural Resources Technical Team as requested by the Norfolk Conservation District.

Landowners and developers will be responsible for installing land treatment measures. Technical assistance for installation of land treatment measures will be provided by the Soil Conservation Service through the Norfolk Conservation District and by the Massachusetts Department of Natural Resources, Division of Forests and Parks, in cooperation with the U.S. Forest Service.

Sponsoring organizations will acquire necessary land rights, execute agreements with landowners for installation of land treatment measures, provide the non-federal share of the installation cost of structural measures, and cooperate with other local, state and federal agencies concerned with the project.

The town of Walpole, which has the necessary legal authority including the power of eminent domain, will acquire the land rights for the structural measures. The non-federal share of the installation costs of structural measures will be borne by the town of Walpole through authorization and funds provided by town meeting action. Land rights related to installation of the channel work include relocation or alteration of public utilities, and repairing of curbing, streets, parking lots and any other public facilities. These items will be included in the construction contract.

Procedures for appraisal and acquisition of land rights will comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, and USDA regulations. Present conditions show that installation of the project will not cause the displacement of persons, businesses or farms as defined by the act. However, if relocations become necessary, relocation assistance advisory services, without PL-566 financial assistance, will be provided by the town of Walpole. This assistance will include: (1) provide personally or by first class mail, written notice of displacement and appropriate application forms to each displaced person, business or farm operation,

(2) assist in filing applications, (3) review and take action on applications for relocation assistance, (4) review and process grievances in connection with displacements, and (5) make relocation payments. As a part of project administration, the Soil Conservation Service will assist the town of Walpole in fulfilling their responsibilities.

Contracting for construction of the structural works will be done by the Massachusetts Water Resources Commission under agreement with the town of Walpole, as authorized by Chapter 602 of the Acts of 1966, as amended, General Court of the Commonwealth of Massachusetts.

Responsibilities for Installation

In order to coordinate the installation of the accelerated land treatment and structural measures provided in the plan and the going conservation programs within the watershed, close cooperation and specific responsibilities are required of private interests, the sponsors, and local, state, and federal agencies assisting in this project.

The Norfolk Conservation District will:

1. Provide local leadership and direction to continue the "going" conservation program of the district within the watershed at the rate which existed prior to the development of this plan.
2. Review development plans to be submitted by town boards and advise concerning land treatment needs.
3. Provide local leadership to insure the timely installation of needed land treatment measures on private and public lands.
4. Review land treatment needs periodically and adjust the land treatment program, if needed, to reflect current requirements.

The Soil Conservation Service will:

1. Assist the Norfolk Conservation District in furnishing technical assistance to landowners and others in determination of land use and application of treatments.
2. Assist the Norfolk Conservation District in furnishing consultative and other technical assistance to review and comment on development plans for lands undergoing development for urban uses.
3. Furnish technical assistance, as a member of the Natural Resources Technical Team, in preparing natural resource inventories and plans.

4. Furnish the engineering services for engineering surveys, final designs, construction plans, and specifications for the installation of structural measures.
5. Bear the project administration costs it incurs for installation of structural measures.
6. Provide construction funds for the project in accordance with the cost sharing set forth herein or as revised by mutual agreement.

The U.S. Forest Service will:

1. Provide guidance and direction to the Massachusetts Division of Forests and Parks for implementation of the proposed forestry program.

The Massachusetts Division of Forests and Parks will:

1. In cooperation with the U.S. Forest Service, furnish consultive and other technical assistance through the Norfolk Conservation District to town boards, landowners and others for the determination of needed practices and installation of forest treatment measures.
2. In cooperation with the U.S. Forest Service, furnish consultive and other technical assistance through the Norfolk Conservation District for forest lands undergoing development for urban uses.
3. Participate as a member of the Natural Resources Technical Team in natural resource inventories and planning.

The Division of Water Resources, Massachusetts Water Resources Commission, consistent with authorities and funding authorized under Chapter 602 of the Acts of 1966, as amended; and as necessary to meet the objectives included in this plan, will:

1. Enter into an agreement with the town of Walpole for the Commission to be the contracting authority to construct the Allen site multiple-purpose structure and the channel work.
2. Act as Contracting Local Organization for the construction of the Allen site multiple-purpose structure and the channel work.

The town of Walpole will:

1. Furnish all the legal, survey and engineering costs for acquiring the necessary land rights, including costs associated with relocation and modification of existing facilities.

2. Pay 50 percent of the construction costs allocated to fish and wildlife for the Allen site multiple-purpose structure.
3. Bear the costs of project administration incurred, including the administration of contracts, for installation of the Allen site multiple-purpose structure and the channel work.
4. Provide funds to pay 100 percent of the land rights costs, including costs of land to be purchased, easements, and rights-of-way to be provided, and relocation or modifications of existing facilities for the Allen site multiple-purpose structure and the channel work.
5. Enter into an agreement with the Massachusetts Water Resources Commission for the Commission to be the contracting authority to construct the Allen site multiple-purpose structure and the channel work.
6. Provide development plans to the Norfolk Conservation District for review and comment.

Installation Schedule

The land treatment measures included in this plan will be applied by landowners and developers during the project period of five years. Acquisition of land rights, geologic investigations and preparation of the design and contract for the Allen site multiple-purpose structure will be completed during the first year of the project period. During the second year, the Allen site structure will be constructed, land rights will be acquired, geologic investigations and surveys will be made, and the final design and contract prepared for the channel work. The channel work will be constructed during the third year. Land treatment measures will continue to be applied during the remaining two years.

FINANCING PROJECT INSTALLATIONLand Treatment Measures

Costs for application of land treatment measures will be borne by owners, operators, and developers with cost sharing and technical assistance available through conservation programs.

Technical assistance provided by the Norfolk Conservation District and Massachusetts Department of Natural Resources, Division of Forests and Parks, will be funded from regular program funds of the Soil Conservation Service, Forest Service, and Division of Forests and Parks, supplemented by PL-566 funds to accelerate application of land treatment measures. The Soil Conservation Service will use \$2,200 of PL-566 funds to accelerate technical assistance and to assist in preparing natural resource plans; the Forest Service in cooperation with the Massachusetts Department of Natural Resources, Division of Forests and Parks, will use \$2,100. "Other" funds required for preparation of natural resource inventories and plans will be provided by the agency or organization involved through its regular budgetary methods.

Structural Measures

Nonfederal funds for installation of the structural measures will be provided by the town of Walpole. Most of the land required for the Allen site multiple-purpose structure has been acquired by the town of Walpole, and acquisition proceedings are under way for the remaining land rights needed. Funds that have been appropriated by town meeting action for flood control uses will be used by the town of Walpole to meet its estimated financial obligations. Any additional funds will be obtained through warrants in future town meetings.

Installation costs allocated to PL 566 funds will be from funds appropriated under the authority of Public Law 566, 83rd Congress, 68 Stat. 666, as amended. This watershed plan does not constitute a financial document for obligation of federal funds, and financial or other assistance by the Soil Conservation Service is contingent upon the appropriation of funds for this purpose.

Prior to entering into agreements that obligate funds of the Service, the Massachusetts Water Resources Commission, who will be the contracting authority under agreement with the town of Walpole will have a financial management system for control, accountability, and disclosure of PL 566 funds received, and for control and accountability for property and other assets purchased with PL 566 funds.

Program income earned during the grant period will be reported on the request for advance or reimbursement from the Service.

PROVISIONS FOR OPERATION AND MAINTENANCELand Treatment Measures

Operation and maintenance of land treatment measures will be the responsibility of the Norfolk Conservation District and will be performed by the landowners of properties on which the measures are installed. Technical assistance will be provided by the Norfolk Conservation District with assistance from the Soil Conservation Service and the Massachusetts Department of Natural Resources, Division of Forests and Parks, in cooperation with U.S. Forest Service.

Structural Measures

Structural measures will be operated and maintained by the town of Walpole from available tax funds. Operation and maintenance will be carried out in accordance with the "Commonwealth of Massachusetts Watershed Operation and Maintenance Handbook for Projects Installed with the Assistance of the Soil Conservation Service," dated May 1971. The average annual cost for operation and maintenance is estimated to be \$1,220 for the floodwater retarding structure and \$1,910 for the channel work.

For three years after completion of the structure, the sponsors and the Soil Conservation Service will inspect each structural measure annually, and after each major storm or other unusual occurrence. After three years, the town of Walpole will make the inspections with participation by the Service and the Norfolk Conservation District as deemed necessary. The needed maintenance will be decided at the time of the inspection. The town of Walpole will perform the needed maintenance work in a timely and otherwise appropriate manner to assure safe and efficient operation of the structural measures for the life of the project.

A specific operation and maintenance agreement between the town of Walpole and the Service will be executed for each structural measure prior to the issuance of invitations to bid for any construction contract. The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with PL-566 financial assistance. A plan of operation and maintenance detailing the major needs will also be included in the operation and maintenance agreement. Maintaining and improving the aesthetic value of the structural sites will be an important consideration in the maintenance program.

Operation and maintenance work at the Allen site dam will include such activities as the removal of brush and debris around the dam and spillways; maintenance of vegetal cover by reseeding, fertilizing, and mowing; control of unwanted vegetation; and replacement or repair of the metal and concrete appurtenances. Access for operation and maintenance will be provided from Washington Street.

Principal items of operation and maintenance for the fish and wildlife pool will include: stocking and periodic reclamation for the fishery, control of undesirable vegetation, policing the site to remove litter, and upkeep of access facilities. The town will request consultation and technical assistance from the Massachusetts Division of Fisheries and Game to develop a management program so that the fish and wildlife measure will serve the purpose for which it is installed. To preclude the development of unsanitary conditions at the Allen site, the town of Walpole will make periodic inspections during and after each season of use. The town will request the Massachusetts Department of Public Health to participate in these inspections. Should these inspections show that unsanitary conditions exist, the town of Walpole will install adequate sanitary facilities to ensure that sanitation is maintained and that operations are in agreement with state and local health laws and regulations.

The total estimated average annual operation and maintenance cost for the Allen site multiple-purpose structure is \$1,220.

Operation and maintenance of the floodwater conduit and outlet channel will include maintenance of vegetation, upkeep of access roads, and travelways; removal of trash and debris, control of undesirable vegetation in the inlet and outlet channel areas; and maintenance of riprap and concrete appurtenances in a good state of repair.

Operation and maintenance of the existing conduit is essential to provide the planned degree of flood protection. Operation and maintenance items will include the removal of trash, debris and undesirable vegetation at the inlet and outlet areas and maintenance of the structural integrity of the conduit.

Operation and maintenance costs for the floodwater conduit, outlet channel, and existing conduit is estimated at \$1,910 annually.

An establishment period of three years is provided for the structural measures and associated vegetative cover. During this period, PL-566 funds may be used by the Soil Conservation Service to cost share on repairs or other work resulting from unknown conditions or construction deficiencies. The cost of such work would be shared in the same ratio as the construction cost of the structure. Maintenance work and work resulting from improper operation and maintenance are not eligible for PL-566 financial assistance. However, technical assistance that may be needed will be provided by the Soil Conservation Service.

Nonstructural Measures

The town of Walpole will continue to implement and enforce the nonstructural measures throughout the project life.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
DIAMOND BROOK WATERSHED, MASSACHUSETTS

Installation Cost Item	Unit	Number		Estimated Cost (Dollars) 1/						TOTAL
				PL-566 Funds			Other			
				Non-Fed. Land	Total	FS 3/	Non-federal Land		Total	
							SCS 3/	FS 3/		
LAND TREATMENT										
Land Acres 2/										
Cropland	Acres	4								600
Forest Land		200	4							6,700
Urban and Built-up		40	200							60,000
Other Land		47	40							8,400
			47							
Technical Assistance										
TOTAL LAND TREATMENT	xxxx	xxxx	xxxx				2,200	2,100	4,300	5,600
							2,200	2,100	4,300	81,300
STRUCTURAL MEASURES										
Construction										
Multiple-Purpose Structures	No.	1					336,900		336,900	31,100
Channel Work										
(M) 4/										
Subtotal-Construction	Feet	1,180					282,000		282,000	282,000
							618,900		618,900	31,100
Engineering Services							65,000		65,000	65,000
Project Administration										
Construction Inspection							57,600		57,600	2,700
Other							57,600		57,600	7,100
Subtotal-Administration							115,200		115,200	9,800
Other Costs										
Land Rights										
Subtotal-Other										
							799,100		799,100	93,600
TOTAL STRUCTURAL MEASURES										93,600
TOTAL PROJECT							801,300	2,100	803,400	211,500
								7,100		1,014,900

1/Price base 1975 2/Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas. 3/Federal agency responsible for assisting in installation of works of improvement. 4/Type of channel before project: (M) - man-made ditch or previously modified channel.

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Diamond Brook Watershed, Massachusetts

(Dollars) 1/

Item	Installation Cost PL-566 Funds			Installation Cost - Other Funds			Total Installation Cost
	Con- struc- tion	Engi- neering	Total PL-566	Con- struc- tion	Land Rights	Total Other	
<u>Multiple-Purpose Structure:</u> Allen Site	336,900	36,800	373,700	31,100	41,300	72,400	446,100
<u>Single-Purpose Structure:</u> Channel Work (M) <u>4/</u>	282,000	28,200	310,200	--	52,300 <u>3/</u>	52,300	362,500
Subtotal	618,900	65,000	683,900	31,100	93,600	124,700	808,600
Project Administration	xx	xx	115,200	xx	xx	9,800	125,000
GRAND TOTAL	618,900	65,000	799,100	31,100	93,600 <u>2/</u>	134,500	933,600

1/ Price Base 1975.

2/ Includes \$9,000 for survey, legal fees, and other costs.

3/ Includes \$28,800 for relocation and modification of utilities, \$5,400 for repaving of streets and parking lots, \$6,000 railroad costs, and \$4,200 for associated engineering services.

4/ Type of channel before project: (M) - manmade or previously modified channel.

December 1975

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY
Diamond Brook Watershed, Massachusetts
(Dollars)^{1/}

Item	COST ALLOCATION			COST SHARING				
	Purpose			PL-566			Other	
	Flood Preven.	Fish & Wildlife	Total	Flood Preven.	Fish & Wildlife	Total	Flood Preven.	Fish & Wildlife
<u>Multiple-Purpose Structure:</u> Allen Site	336,400	109,700	446,100	336,400	37,300	373,700	--	72,400
<u>Single-Purpose Structure:</u> Channel Work	362,500	--	362,500	310,200	--	310,200	52,300	--
GRAND TOTAL	698,900	109,700	808,600	646,600	37,300	683,900	52,300	72,400

^{1/} Price base 1975.

December 1975

TABLE 3 - STRUCTURE DATA
for
STRUCTURE WITH PLANNED STORAGE CAPACITY
Diamond Brook Watershed, Massachusetts

Item	Unit	Allen Site
Class of Structure		c
Drainage Area (Diamond Brook)		
Total	Sq. Mi.	1.0
Curve No. (1-day) (AMC II)		75
T_c	Hrs.	1.0
Elevation Top of Dam	Ft.	198.0
Elevation Crest Emergency Spillway	Ft.	193.0
Elevation Crest Low Stage Inlet	Ft.	184.5
Maximum Height of Dam	Ft.	22
Volume of Fill	Cu. Yds.	54,100
Total Capacity ^{1/}	Ac. Ft.	255
Sediment-100 year Accumulation	Ac. Ft.	5
Beneficial Use (Fish and Wildlife)	Ac. Ft.	43
Retarding	Ac. Ft.	207
Surface Area		
Beneficial use pool (Fish & Wildlife)	Acres	17
Retarding pool ^{1/}	Acres	36
Principal Spillway Design		
Rainfall Volume (areal) (1 day)	In.	6.7
Rainfall Volume (areal) (10 day)	In.	13.3
Runoff Volume (10 day)	In.	7.38
Capacity-Single Stage (Max.)	cfs.	51
Frequency operation-Emerg. Spillway	% change	< 1
Size of Conduit	Diam.-In.	30
Emergency Spillway Design		
Rainfall Volume (ESH) (areal)	In.	9.9
Runoff Volume (ESH)	In.	6.78
Storm Duration	Hrs.	6.0
Type		Vegetated
Bottom Width	Ft.	120
Velocity of Flow (V_e)	Ft./Sec.	5.4
Slope of exit channel	Ft./Ft.	0.035
Maximum water surface elevation	Ft.	194.5
Freeboard Design		
Rainfall Volume (FH) (areal)	In.	24.0
Runoff Volume (FH)	In.	20.4
Storm Duration	Hrs.	6.0
Maximum water surface elevation	Ft.	197.9
Capacity Equivalents		
Sediment Volume	In.	0.1
Retarding Volume	In.	3.9
Beneficial Volume	In.	.8

^{1/} Crest of Emergency Spillway.

TABLE 3A - STRUCTURE DATA CHANNEL

Diamond Brook Watershed, ^{1/}Massachusetts

Station	Capacity		Water Surface Elev. Ft.	Channel Gradient (ft./ft)	Channel Dimensions			"n" Value		Velocities		Exca- vation (Cu. yds.)	Type of Work	Before Project	
	Req. (cfs)	Design (cfs)			Bottom (ft.)	Depth (ft.)	Side Slopes	Aged	As Built	Aged (fps)	As Built (fps)			Type of Channel	Flow Con.
131+67 to 139+47	510 ^{4/}	510	140.2 136.5	0.0013			--	--	--	-	--	4,200	I _L	M	Pr
139+20 to 139+61 ^{2/}	65 ^{5/}	65	134.8+	0.0	20	4.8	1.5:1	0.025	.020	0.5 ^{3/}	0.5 ^{3/}		II	M	Pr
139+61 to 143+20	316 ^{5/}	316	134.8	0.0	20	4.8	1.5:1	0.025	.020	2.5 ^{3/}	2.5 ^{3/}	1,680	II	M	Pr

^{1/} Drainage Area = 1.98 sq. miles.^{2/} Upstream of proposed conduit outlet in original channel.^{3/} Influenced by tailwater from the Neponset River.^{4/} Conduit designed for "Diane" Flood, August 1955, (Flood of Record) modified by upstream floodwater retarding structure. Total discharge is 670 cfs, of which 160 cfs, will pass through existing conduit and 510 cfs will be passed by the additional conduit proposed in this work plan.^{5/} Channel designed for 100-year frequency flow.^{6/} I_L - establishment of new channel (reinforced Concrete Conduit). II - enlargement or realignment of existing channel or stream.^{7/} M - manmade or previously modified channel. Date of original major construction not known.^{8/} Pr - perennial - flows at all times except during extreme drought.

December 1975



TABLE 4 - ANNUAL COST
Diamond Brook Watershed, Massachusetts

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost <u>2/</u>	Operation and Maintenance Cost	Total
<u>All Structural Measures</u>	41,200 (6,470)	2,780 (350)	43,980 (6,820) <u>3/</u>
Project Administration	7,370	--	7,370
GRAND TOTAL	48,570	2,780	51,350

1/ Price base 1975.

2/ 100 years at 5 7/8 percent interest.

3/ Fish and Wildlife costs not included in totals.

December 1975

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Diamond Brook Watershed, Massachusetts

(Dollars) 1/

Item	Estimated Average Annual Damage <u>2/</u>		Damage Reduction Benefits
	Without Project	With Project	
<u>Floodwater</u>			
Residential	10,010	60	9,950
Commercial	45,190	0	45,190
Road and Bridge	12,020	890	11,130
Subtotal	67,220	950	66,270
Indirect	16,300	230	16,070
TOTAL	83,520	1,180	82,340

1/ Price base 1975.

2/ Damages and benefits were not evaluated for floods of greater magnitude than 500-year frequency.

December 1975

CONTENTS

ORIGINAL ARTICLES	PAGES
THE PROBLEM OF THE PHYSICIAN IN THE PRESENT ECONOMIC SITUATION	1
THE PHYSICIAN AND THE PUBLIC	15
THE PHYSICIAN AND THE PATIENT	25
THE PHYSICIAN AND THE COMMUNITY	35
THE PHYSICIAN AND THE FUTURE	45
THE PHYSICIAN AND THE ETHICS	55
THE PHYSICIAN AND THE LAW	65
THE PHYSICIAN AND THE ECONOMICS	75
THE PHYSICIAN AND THE POLITICS	85
THE PHYSICIAN AND THE SOCIETY	95
THE PHYSICIAN AND THE HUMANITY	105

Published by the American Medical Association, 535 North Dearborn Street, Chicago, Ill.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Diamond Brook Watershed, Massachusetts

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS		Total	Avg. <u>3/</u> Annual Cost	Benefit Cost Ratio
	Damage Reduction	Secondary			
<u>All Structural Measures:</u>	80,730	6,630	87,360	43,980	2.0:1
Project Administration	--	--	--	7,370	--
GRAND TOTAL	80,730 <u>2/</u>	6,630	87,360	51,350	1.7:1

1/ Price base 1975.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$1,610 annually.

3/ From Table 4.



INVESTIGATIONS AND ANALYSES

PROJECT FORMULATION

Watershed problems were defined through discussions with the Sponsors and through investigations. The extent of the investigations and analyses necessary for project formulation was based on the project objectives of the Sponsors and the criteria, procedures and policies set forth in the Watershed Protection Handbook, Technical Releases, and National Memoranda. Investigations were planned jointly by participating agencies and Sponsors and carried out to determine the most feasible solutions to the problems.

The Massachusetts Historical Commission and the State Archaeologist were consulted regarding the presence of historical and archaeological sites that may be affected by the project. Both responded that their present listings show no sites that would be affected. In addition, a survey has been carried out by a qualified archaeologist. This survey shows that no archaeological resources will be adversely affected by project measures. A copy of the survey report is included as an appendix to the environmental impact statement for this project.

Land Treatment Measures

An investigation of land treatment needs of the watershed was made as the first increment of project formulation. This investigation consisted of a search of District and Service records, field observations, and consultations with the District Supervisors, agency personnel, landowners, and town officials. Land treatment measures were outlined where investigations showed a need for treatment.

Information on the hydrologic condition of the forest land in the watershed and the reasons for the present hydrologic condition were obtained in a series of systematically selected observation plots. This information served as the basis for developing precipitation-runoff curve numbers and land treatment needs for forest land. The data obtained included measurements of the litter and humus layers, determination of soil type, and other hydrologic factors; and recording the presence or absence of disturbance factors, such as fire, grazing, cutting, logging and the abnormal infestation of insects or increased fire hazard.

Forest fire protection is being provided by the towns of Walpole and Sharon and the Massachusetts Department of Natural Resources, Division of Forests and Parks in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program. Established fire loss goals have been met and the present degree of protection afforded is adequate to meet any increased hazard and risk resulting from the project's installation.

Land treatment needs are primarily related to conversion of land to urban uses. The extent of these needs was determined on the basis of

projected land use changes expected to result from urban development. From records of past development, it was estimated that construction of 10 homes or about 6 acres of residential development will occur annually, and that 2 acres of land will be developed annually for commercial and industrial uses.

Fish and Wildlife Measure

The proposed water resource improvement for fish and wildlife, in the Allen site multiple-purpose structure, was based on an evaluation of the need, the desire of the Sponsors and potential for development to achieve the maximum enhancement value. The Massachusetts Division of Fisheries and Game assisted the Service and the Sponsors in this evaluation.

Structural Measures

It became obvious that structural measures would be needed to supplement the land treatment measures to accomplish the objectives of the Sponsors. The primary basis for determining the structural measures to be included in this plan was to provide the maximum level of flood protection and multiple-purpose use within the limits of sound economic and engineering practices.

Several formulations, including the selected project, were evaluated to determine their comparative advantages. Project measures were selected to provide the maximum net benefit with the least annual cost, without regard to the relative federal and nonfederal shares of the cost.

Engineering and geologic studies were made to identify and prepare preliminary designs and costs for probable structural measures that appeared to have potential for meeting the Sponsors' objectives in alleviating the flood problems. Hydrologic and economic evaluations of measures and combinations of measures were made to determine their effects on flood stages and related damages.

HYDRAULICS AND HYDROLOGY

The following hydrologic and hydraulic data and procedures were used in the design of the structural measures and to determine effects of these measures in reducing floodwater damages; these procedures, if not referenced, are described in the Soil Conservation Service National Engineering Handbook, Section 4, Hydrology.

Rainfall-frequency curves for the watershed were developed from U.S. Weather Bureau Technical Papers Nos. 40 and 49. These curves were used as the basis for predicting the frequency of discharge occurrences since no stream gages with adequate records are located within the watershed or on nearby

similar sized watersheds. The U.S. Geological Survey stream gage records of the Neponset River at Norwood, Massachusetts (D.A. = 35.2 square miles with 28 years of record) and the East Branch of the Neponset River at Canton, Massachusetts (D.A. = 27.2 square miles with 16 years of record) were analyzed to determine the frequency of tailwater on the existing conduit on Diamond Brook and to obtain runoff volumes of historical floods on Diamond Brook.

Present and future soil-cover complex runoff curve numbers were computed from land use and soils data furnished by the Norfolk Conservation District, the Service and the U.S. Forest Service. The future condition, which includes expected urban development in the watershed, was used as the basis for project evaluation. Annual series runoff-frequency curves were developed from the rainfall-frequency and runoff curve number data.

The discharge-runoff relationships for the watershed were obtained by flood routing. The Project Formulation-Hydrology computer program outlined in SCS Technical Release No. 20, was used for subwatershed routings through the ponds and stream reaches. The Diamond Brook drainage area was subdivided into 11 subwatersheds for evaluation. Times of concentration for these subwatershed areas were computed by stream hydraulic methods. Reach travel times were based on the average flood velocities. To take advantage of the available natural flood storage, floods on Diamond Brook were routed through Memorial, Diamond and Clark Ponds as well as Main Street and Washington Street road crossings which function similar to low dams. Flood routings were made for the 2-year, 10-year, and 100-year, Type II, twenty-four hour evaluation storms and for the August 1955 and March 1968 floods. The present (without project) and the future (with project) conditions were routed.

Frequency was related to discharges through the routed peak discharge-runoff and the rainfall-runoff-frequency relationships.

All engineering field surveys were referenced to or converted to Mean Sea Level. The flood plain surveys on Diamond Brook consisted of 15 valley cross sections, 10 road profiles with culverts, bridge and/or pond spillway sections and additional profiles with miscellaneous shots in the Memorial Pond - Main Street area. Eight more valley sections were surveyed on the Neponset River from the Diamond Brook confluence to Route 1A (Main Street). Additional engineering data for hydraulic studies include: a reconnaissance by boat of the inside of the Diamond Brook-Main Street conduit; an engineering report on the Main Street conduit (1962) prepared for the town of Walpole by consulting firms; and 1958 plans of the Massachusetts Department of Public Works for the extension of the Main Street conduit and improvement of its outlet downstream.

Discharge rating curves were developed by hydraulic calculations at the control sections. These calculations were supplemented with water surface profiles developed by the Modified Leach Step Method to determine tailwater conditions with project on the proposed floodwater conduit and on the Memorial Pond outlet.

The Neponset River, below the confluence with Diamond Brook, was also studied to determine the effect of the Neponset River tailwater on the existing and proposed conduit outlets on Diamond Brook. The need for reconstruction or removal of the seven foot high Stetson Pond Dam, located 0.4 mile downstream of the confluence, was examined. Water surface profiles were developed by the Modified Leach Step Method and checked by the Upper Darby Water Surface Profile Computer Program. The results showed that the present Stetson Dam has an insignificant effect on the stages on Diamond Brook. The evaluation of floodwater damages and the floodwater conduit design were based on a tailwater condition assuming the average probability of occurrence of peak flow from Diamond Brook combining with 60 percent of the Neponset River peak flow at the same frequency. This was developed from the stream gage data, hydrograph shape, timing and watershed characteristics. The flood profile (Figure 4) however, shows the 100-year Neponset River flood elevation where it is higher than this evaluation condition.

Frequency-elevation data for each control section were tabulated from both the discharge-elevation and the routed frequency-runoff-discharge relationships for use in the urban damage evaluation. Tabulations on Diamond Brook included present and future conditions for structural alternatives of: retarding structure only; floodwater conduit and outlet channel only; and a combination of these measures.

The design hydrographs developed for the reservoir site were in accordance with Soil Conservation Service standards set forth in Engineering Memorandum SCS-27. To ensure infrequent operation of the emergency spillway, the floodwater storage capacity was increased 33 percent.

To determine the proposed floodwater conduit design discharge, the criterion used was the peak discharge capacity needed in downtown Walpole to safely pass another August 1955-type storm (assuming the proposed reservoir to be in operation) without causing significant flood damage. This peak discharge was obtained from the evaluation flood routings of the August 1955 storm. The planned total capacity of the existing and the proposed conduit and outlet channel is 670 cubic feet per second without flooding Main Street.

ECONOMICS

The basic information on flood damage was obtained from personal interviews with property owners and town officials and recorded on flood damage schedules. This information is related to the flood of August 18, 19, 1955. The sponsoring organization cooperated in contacting the owners of all commercial and residential property along the Diamond Brook flood plain. Damages for stages above and below the 1955 flood were appraised in one foot increments.

The damage estimates were tabulated by stages and converted to current normalized prices. Appropriate factors were applied to account for future development without a project and for increased values associated with projected per capita income. These factors were developed using TSC Technical Note UD-26 and personal income projections for BEA economic area 4.

Flood damages and benefits were computed using the frequency method described in Chapter 3, page 2 of the Economics Guide, Soil Conservation Service.

Separate damage-frequency analyses were developed for each reach using the frequency-stage data provided by the hydrologic study. Damages and benefits to residential, municipal and commercial property were computed under (1) conditions without the project; (2) conditions with the proposed land treatment installed; (3) conditions with land treatment and the retarding structure installed; (4) conditions with land treatment and the channel work installed; and (5) conditions with all measures installed. Indirect floodwater damages were estimated to be 20 percent of the direct residential damages and 25 percent of the direct commercial and road and bridge damage.

The fish and wildlife measure is for improvement and preservation of habitat; therefore, fish and wildlife benefits were assumed to be equal to the costs of these measures. These costs and benefits were not included in the totals in Tables 4 and 6.

Three structural alternatives were evaluated for Diamond Brook. This included the multiple-purpose flood prevention, fish and wildlife structure, the floodwater conduit and outlet channel and a combination of these. It was determined that the combination of structural measures was necessary to reach a satisfactory level of damage reduction in the major damage area of the watershed.

The value of local secondary benefits stemming from the project were estimated to be 10 percent of the direct primary benefits. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

Improved water quality in the stream and existing ponds, through reduced sedimentation, will result from project measures. However, actual sediment volumes are not significant and no attempt was made to evaluate this benefit.

All project installation costs were based on 1975 price levels. These costs were amortized over a 100-year period at $5 \frac{7}{8}$ percent interest. Operation and maintenance costs have been converted to adjusted normalized prices and projected to reflect rising prices using appropriate BEA Factors.

ENGINEERING

Storage Sites

Two potential storage sites were identified and located on $7\frac{1}{2}$ -minute USGS quadrangle maps by a map study and field reconnaissance. Preliminary designs and cost estimates were prepared for each site, using data developed from the USGS quadrangle maps. The Allen site, just upstream of Washington Street, was selected for further consideration based upon the preliminary cost estimates and the relative effectiveness in solving watershed problems and meeting project objectives.

A detailed topographic map of the Allen site was developed by field survey. Stage-area and stage-storage curves and a preliminary design were made using these topographic maps.

The town of Walpole, with the assistance of federal and state agencies, determined the multiple-purpose use to be included in the Allen site. Based upon the site data developed and the results of on-site geologic investigations, the town of Walpole selected the elevation and size of the fish and wildlife pool.

The Allen site multiple-purpose structure will consist of an earthen dam with a principal spillway and a vegetated emergency spillway. The principal spillway crest will be at the elevation of the fish and wildlife pool. This principal spillway will consist of a reinforced concrete riser, outlet pipe conduit and a reinforced concrete impact structure. A water control gate will be included in the riser to allow draining of the fish and wildlife pool. The emergency spillway, located in an earth cut on the left abutment, will have topsoil placed on the control section and exit channel to aid in establishing vegetation to improve the erosion resistance of these areas. Borrow for the earthen dam will be obtained from the emergency spillway cut and from borrow areas developed on or near the site.

Channel Work

Planning investigations showed that a floodwater conduit and entrance and outlet channel improvement would be needed to supplement the Allen site multiple-purpose structure to provide the desired degree of protection in the business area of Walpole. The design capacity for this floodwater conduit and outlet channel is based on the flood peak of a storm equal to the August 1955 event as modified by expected future watershed conditions and the Allen site multiple-purpose structure. The energy head available to handle this discharge is limited by tailwater from the Neponset River.

An additional 780 foot long, reinforced concrete conduit and an enlarged channel section downstream were found to be the most feasible solution for achieving the required capacity. The conduit system will consist of either twin 72-inch diameter conduits or a single 72-inch high by 113-inch wide oval conduit. Final selection of the conduit system will be based on detailed geologic investigation of the conduit route, the possibility of excavating the portion of the route under the railroad embankment, and the relative cost of each system.

The enlarged channel section downstream from the conduit outlet was designed to safely carry the 100-year discharge. Tailwater conditions were based on the peak flow of Diamond Brook combining with 60 percent of the peak flow of the Neponset River for a given frequency storm. Stability of the channel section was analyzed to insure that excessive velocities would not be present under tailwater conditions which would occur with a 1-year frequency flow in the Neponset River. The channel was found to be stable under conditions prescribed by SCS criteria, namely: 100-year aged condition, bank full aged condition (if less than 100-year flow elevation), and 10-year as-built condition. Stability analyses were based on preliminary work plan geologic investigations. Detailed geologic investigations of the channel area will be made prior to final design. If these investigations indicate a potential stability problem, design measures will be used to insure a stable channel. Such methods might include flatter side slopes or riprap protection for the channel bottom. It is not anticipated that these measures will be necessary.

Works related to the Diamond Brook channel work consist of the following: minor repairs to the entrance of the existing conduit, an additional reinforced concrete conduit with concrete headwalls; improvement of the entrance channel to the existing and additional conduit; and an enlarged channel section from the conduit outlets to the confluence with the Neponset River.

Designs and Cost Estimates

Work plan designs for structural measures were developed using detailed topographic data, results of geologic investigations, and standard design procedures outlined in the Soil Conservation Service's Technical Releases and National Engineering Handbooks. Work plan design quantities were determined for major cost items including: clearing, clearing and grubbing,

embankment fill, concrete, pipe conduit, earth excavation, dewatering, riprap, placing top soil and seeding. Cost estimates were computed using latest cost information from similar construction work in the Northeast. A contingency item of 12 percent was added to the construction cost estimate. The engineering services cost, land-rights cost, and project administration cost were estimated using experience gained in construction of other PL-566 projects in Massachusetts. Work plan designs and costs were then reviewed with the Sponsors, Soil Conservation Service Design Section and participating state agencies.

GEOLOGY

General

Bedrock of the watershed area consists of igneous rocks (granite) located generally in the upstream third of the watershed, and sedimentary rocks (red and gray sandstone, shale and conglomerates) in the remaining area. The bedrock is overlain by glacial deposits consisting mainly of kames, kame terraces and ground moraine. There are small areas of swamp, lacustrine silts, ice channel and unclassified sand and gravel deposits. Exposures of bedrock are limited to the higher elevations of the watershed in the area of Moose Hill.

Foundation Investigations

Preliminary geologic investigations were made to determine apparent subsurface conditions and engineering characteristics of structural sites. Information from these investigations was used to determine geologic feasibility and in preparing cost estimates of structures considered in the preliminary stage of project formulation. These investigations included core-drilling three or more holes along the proposed centerlines; penetration and permeability test; classifications of core materials by sieve analysis; and a determination of design requirements, considering foundation conditions, to ensure stability from potential earthquakes.

Allen Site Multiple-Purpose Structure

The preliminary geologic investigation of the Allen site was supplemented by core-drilling 14 additional holes along the structure centerline, penetration and permeability tests and sieve analysis of core materials. Results of this additional investigation were considered in the work plan design. The geologic investigation of foundation conditions at the Allen site provided data on the general geology and pointed out possible geologic problems. Additional drilling to define these problems and permit appropriate consideration in final design is anticipated. Additional test pitting and laboratory testing and analysis of embankment borrow materials will also be needed for final design of the structure.

The site is in an area of Pleistocene glacial formation. Soil in the left abutment is poorly graded sand and gravel ice channel filling, from 0 to 19 feet thick, underlain by about 15 feet of glacial till. The left portion of the foundation area is glacial outwash, 0 to 15 feet thick underlain by dense glacial till. The foundation on the right and the right abutment are geologically complex, consisting of lenses of silt, sand, and gravel of both glacial outwash and lacustrine origin. Artesian water with hydrostatic heads above ground level occur in some of these lenses. Soil classifications and permeability tests, made at the time of core-drilling, indicate that some water losses will occur in both abutments and some portions of the foundation. Borrow material will be obtained from the emergency spillway and upstream of the right abutment. This material ranges from silty, poorly graded sand and gravel to sandy silt.

The results of the foundation investigation indicate that some adverse conditions exist but it is expected that remedial measures can be designed. It is also expected that dewatering measures will be required during construction.

Channel Work

Glacial deposits along a major portion of the proposed floodwater conduit and outlet channel have been altered by excavations and fillings during urban development. There is no indication that bedrock will be encountered with the depths of excavation required for installing the floodwater conduit and outlet channel, or that foundation or slope stability problems exist. It is anticipated that dewatering measures will be needed to facilitate construction.

Prior to final design detailed investigations will be made to supplement visual observations and available information on geologic conditions. This is particularly important in certain areas of fill.

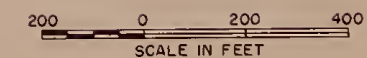
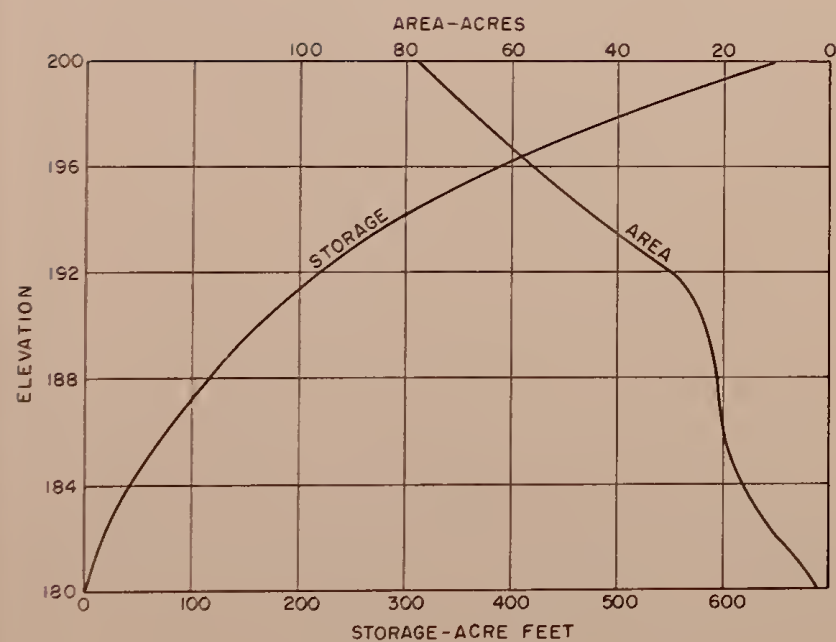
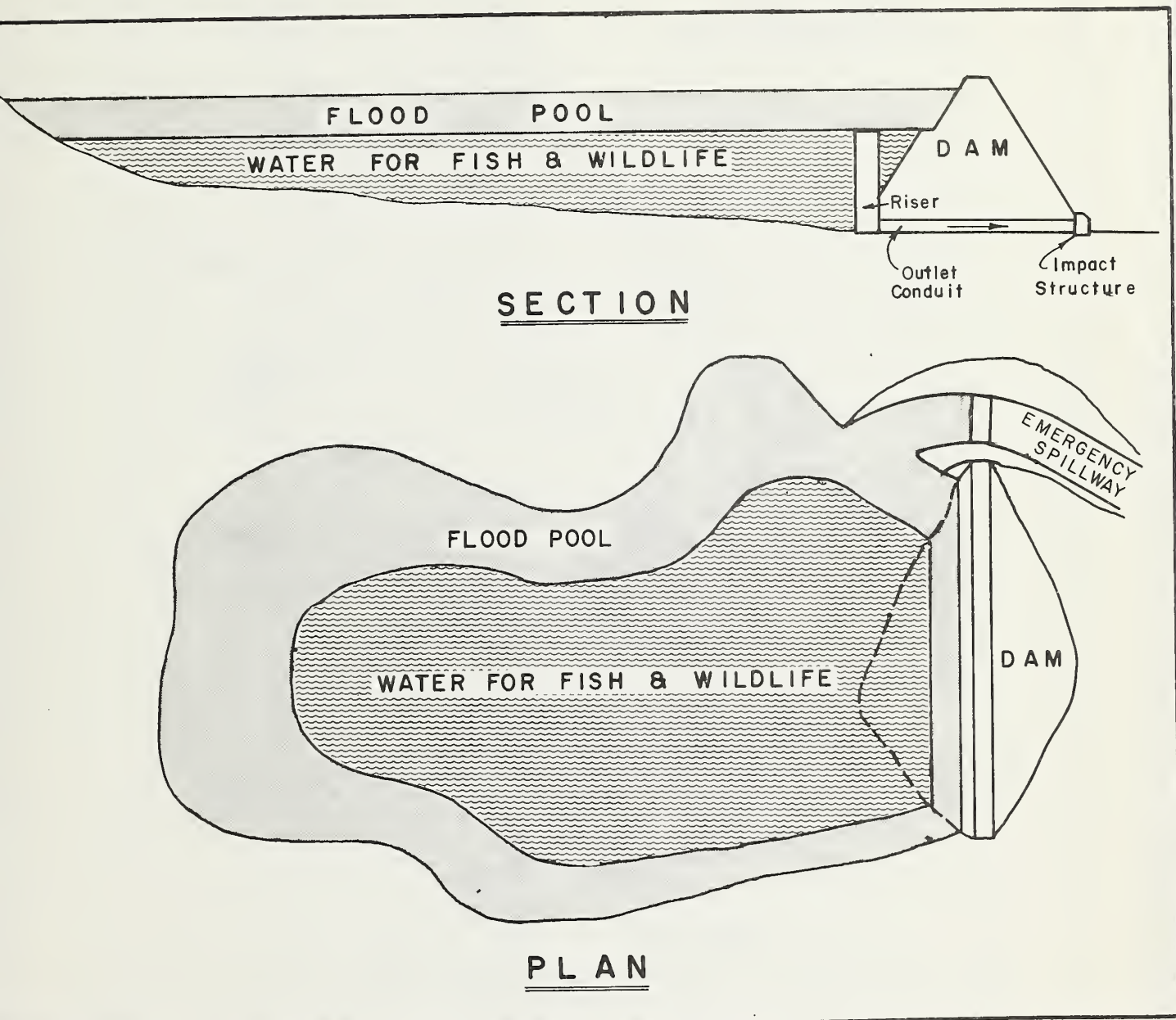


FIGURE 1
PRELIMINARY PLAN
ALLEN SITE RESERVOIR

DIAMOND BROOK WATERSHED
MASSACHUSETTS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TYPICAL MULTIPLE-PURPOSE STRUCTURE



NOTE: Fish and Wildlife pool includes storage for expected sediment accumulation.

Figure 1A

CROSS-SECTION AND PLAN VIEWS OF MULTIPLE PURPOSE STRUCTURE. WATER FOR FISH AND WILDLIFE USES IS STORED BETWEEN FLOOD POOL (ABOVE) AND SEDIMENT STORAGE (BOTTOM POOL)

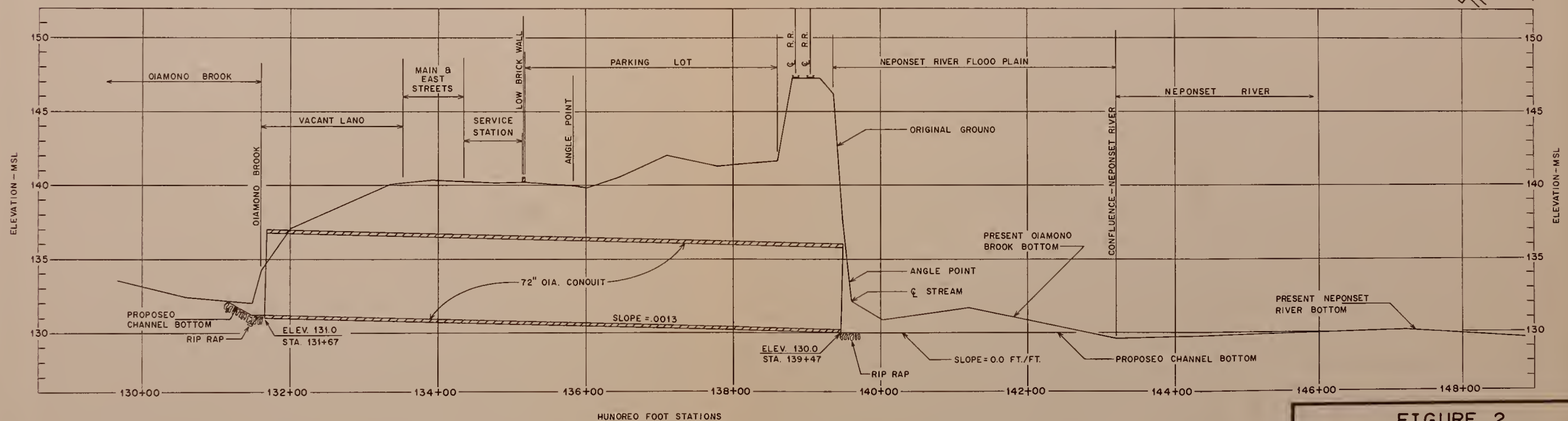
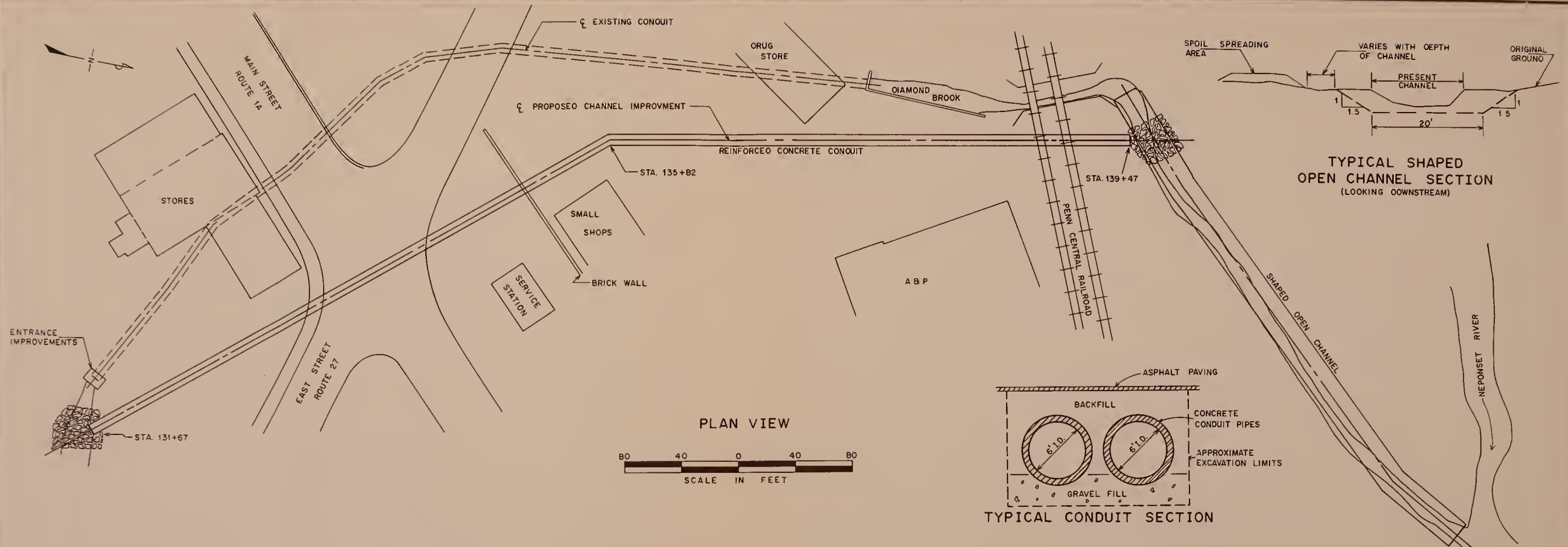


FIGURE 2
PRELIMINARY PLAN
CHANNEL IMPROVEMENT
DIAMOND BROOK WATERSHED
MASSACHUSETTS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



FIGURE 3

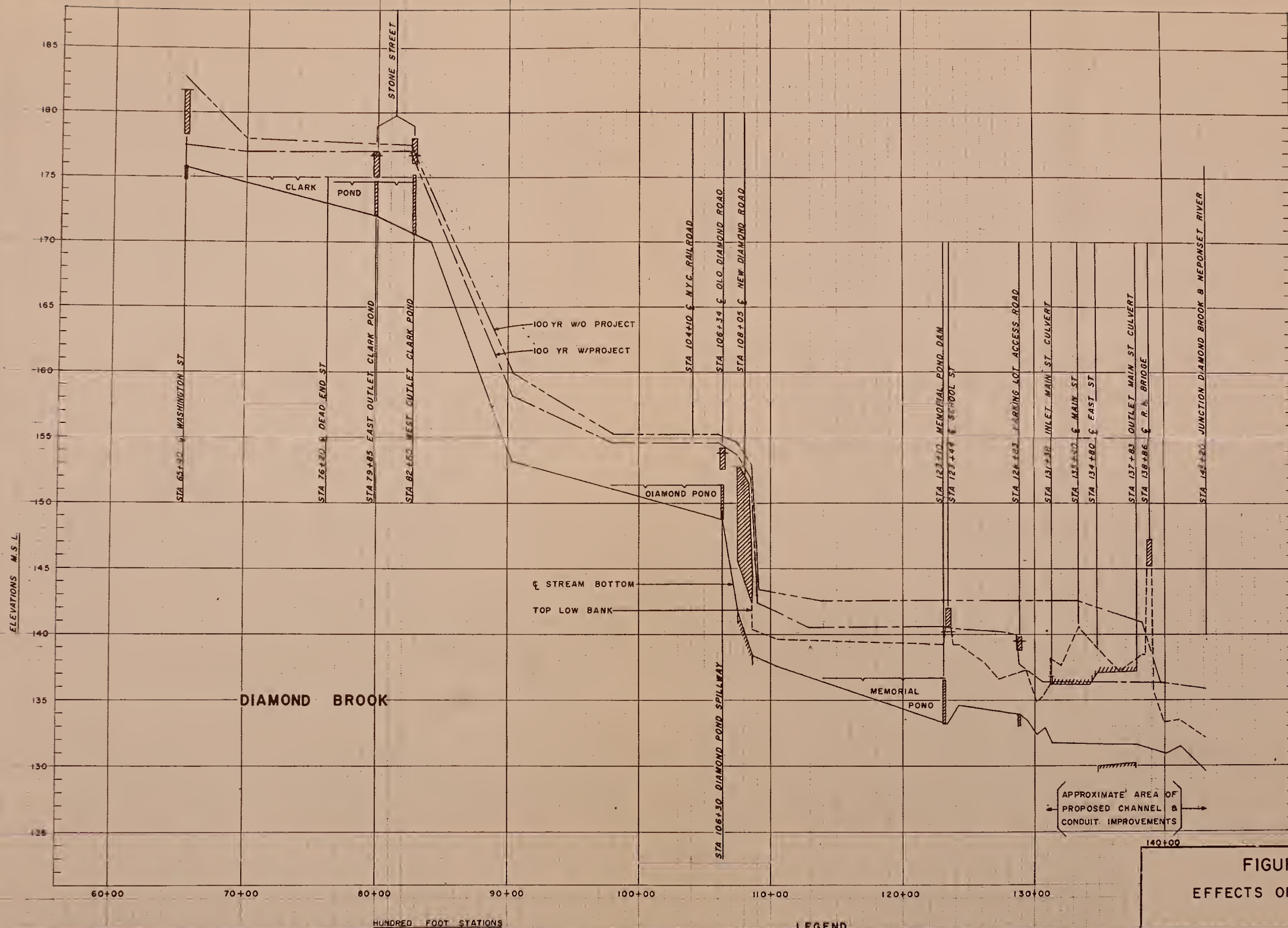


FIGURE 4
EFFECTS OF PROJECT

DIAMOND BROOK WATERSHED
MASSACHUSETTS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

